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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

PROFESSOR PHILIP ROUNSEVILLE ALGER, U. S. NAVY.

AN APPRECIATION.

Written for the Institute by
REAR-ADMIRAL AUSTIN M. KNIGHT, U. S. Navy.

Professor Philip Rounseville Alger, United States Navy, for the last nine years Secretary and Treasurer of the Naval Institute and Editor of its PROCEEDINGS, died at Annapolis, Maryland, on February 23, 1912.

To those who had the privilege of intimate association with Professor Alger, the news of his death has brought a sense of irreparable personal loss. To them, the memory of what he was will always far transcend the memory of what he did and the thought of what he might have done if his life had been prolonged. He had, in a most unusual degree, the gift of making and retaining friends; a gift of which the secret lay partly in his singularly gracious and winning personality and partly in the perfect confidence which he inspired as to his own unwavering loyalty to those whom he admitted to his friendship.

To the wider circle of those who, without intimate acquaintance with the man himself, were familiar with his work, his death means the loss of an uplifting and stimulating force in all the activities of the service which he loved and to which he gave

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himself without reserve through a lifetime—all too short—of fruitful and unselfish labor.

Professor Alger is sometimes thought of, by those who know him only superficially, as essentially a mathematician and a theorist. To a certain extent this view seems justified by the ease with which he dealt with abstract subjects; but any estimate of him is misleading which fails to take account of the practical side of his remarkably versatile intellect.

The son of a New England poet and mystic, he added to the imagination which was his birthright, and which was doubtless the source of the almost unerring instinct with which he went to the heart of every problem which he attacked, a practical common sense which tempered his brilliant intellectuality and kept him loyal to facts as he found them. He was not more intellectually brilliant than he was intellectually honest; and he could abandon a cherished theory which proved untenable, with a wholehearted frankness which was in perfect keeping with the other traits of his modest and generous nature. His remarkable gift for abstract reasoning he regarded always as a means to an end, never as an end in itself; and he never considered any part of his work as finished until he had drawn from it every deduction of practical usefulness which it could be made to yield.

Professor Alger was born at Boston, September 29, 1859. He graduated at the Boston Latin School in 1876, and entered the Naval Academy the same year, graduating four years later at the head of his class. His first cruise, on the *Richmond*, took him to the Pacific Station and to China. Returning in 1882, he was ordered to the Bureau of Ordnance, where he entered thus early in his career upon the path in which he was to win such marked distinction in later years.

By what seems a remarkable coincidence, in view of his extraordinary fitness to meet the demands of the situation, his entrance upon ordnance duty coincided exactly with the beginning of the "New Navy," of steel ships and built-up guns. Coming from a cruise in a wooden corvette of the Civil War period, he was called upon at once to bear a part in the design of guns built up of tempered steel, for ships as strikingly in contrast with the *Richmond* as were these guns with the cast-iron muzzle-loading

smoothbores with which that ship had fought her way past the batteries at New Orleans and Mobile Bay.

The new ships were the *Chicago, Boston, Atlanta* and *Dolphin;* cruisers it is true, and insignificant to-day, but up-to-date in their class when designed, and more heavily armed than any other ships of that day which could properly be compared with them; and, so far as ordnance was concerned, more nearly allied to the battleship of to-day than to the wooden frigates and corvettes which had preceded them.

A second tour of duty afloat, this time in the *Pensacola* on the European Station, from 1885 to 1888, was followed by another assignment to the Bureau of Ordnance, and, a year later (November, 1890), by transfer to the corps of Professors of Mathematics.

With his tenure of duty on shore assured, Professor Alger entered now upon a new phase of his career and for more than nine years was associated intimately, so far as ordnance was concerned, with every step of the remarkable advance which in that brief period carried warship design in the United States from the *Chicago* and *Boston* to the *Maine* and the *Missouri.*

In 1899 Professor Alger left the Bureau of Ordnance to take up the duties of Head of Department of Mechanics at the Naval Academy. In 1903 he was induced to accept the position of Secretary and Treasurer of the Naval Institute, a position which carried with it the editorship of the Institute's PROCEEDINGS; and the following year he resumed his connection with the Bureau of Ordnance by becoming a member of the Special Board on Naval Ordnance. This Board, created in 1904, was designed to act as an advisory board to the Bureau, in connection especially with experimental work in the development and test of ordnance material.

In spite of his connection with the Naval Institute and with the Special Board, he continued his duties at the Naval Academy until 1907, when his direct connection with the Academy was severed; and thereafter until his death he was enabled to give his uninterrupted attention to the Institute and the Special Board.

Professor Alger's career as an educator brought out in strong relief a phase of his many-sided nature which almost justifies the

conviction that here was the sphere, out of the many in which he stood pre-eminent, in which he was fitted for the widest usefulness. This was his generous and sympathetic comprehension of youth—of its promise, its trials, and its aspirations. He felt that his work was but half done when he had given to his students the best that he had to give from his wealth of knowledge and experience. He aspired to touch them at other points and to make his influence count for as much in the development of character as in that of mind. To this end he welcomed all who sought him to the refined and cultured atmosphere of his home; and many a young man found in this atmosphere, at the most impressionable period of his life, just the influence that was needed for the creation of a powerful and lasting impulse toward high ideals.

From the first, Professor Alger's administration of the affairs of the Naval Institute was brilliantly successful; and this not less on the financial than on the literary and professional sides. He rapidly enlarged its publishing department, always with excellent judgment, and added largely to its membership, especially in scientific and engineering circles. His own contributions to the PROCEEDINGS were many and notable, his "Professional Notes," being especially valuable.

The high place which admittedly belongs to the PROCEEDINGS to-day is very largely due to the energy and judgment with which he carried forward and extended the work begun by his predecessors; and those who may come after him will long benefit by the powerful and well-directed impulse which he has given to the Institute's affairs.

Professor Alger's work in Ordnance has already been referred to in general terms. To describe it in detail would call for more space than is here available. Nor is such description needed. More than of any other one man, it is true of him, that the history of the development of naval ordnance in the United States during the last quarter century is a history of his work.

He wrote much on subjects connected with Ordnance and two of his books, "Exterior Ballistics" and "The Elastic Strength of Guns," have long been recognized as standard works upon the subjects with which they deal. Another book, on "Hydromechanics," was prepared for use at the Naval Academy, and has

had a gratifying success as a text book at other institutions. He had planned, and partly outlined, before his health failed, a treatise on "Interior Ballistics," which would have been the crowning work of his career. The subject had attracted him for many years and had so far taken shape in his mind that he hoped to push it rapidly to completion when once it was seriously begun.

The failure of this plan is not the smallest of the losses to the world which are involved in his untimely death.

It is often said that no one is so important that his place cannot be filled. However true this may be, there are many who feel that it will be long before we see again combined those qualities of intellect, of character, and of spirituality, which made up the brilliant and loveable personality of Philip Rounseville Alger.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

PRIZE ESSAY.

NAVAL MIGHT.

By LIEUTENANT RIDGELY HUNT, U. S. Navy.

Motto: Arms and the man.

Other things being equal, the remaining thing will always bring about the desired result. We reason thus in speaking of strategy or tactics, of fleets or ships, as well as of other affairs of life. What is this remaining thing?

If we create two battleships, or fleets, equal in every respect, it will necessitate that in a deadly conflict of one of them with the other, both must at the same moment, from the same causes, and in the same way, go to the bottom. But to create two ships perfectly equal is an impossibility; for although as mechanical structures made by hands they may be duplicates, yet before they can become useful there must be added the human components without which the creations would be utterly worthless. Here it is that the remaining thing comes into view. No matter if the men of the twin vessels be themselves twins, educated and trained together and always subjected to the same influences, yet will their two ships not be the same, for in the unseen movements of the one human mind there enter thoughts, ideas, conclusions beyond the conception or influence of the other human mind. We call this the personal equation.

As a consequence of this one unequal thing, where all other things are equal, each ship will be distinguished by her own individuality which will be reflected in the zeal, hope and confidence of the people on board her, and which will denote such a difference between the two ships as to insure that in a deadly conflict only one of them will go to the bottom. If, for example, the *Florida* and her sister ship the *Utah* were to engage one another

in battle, that one with the more competent captain and the more skilful crew would conquer; a self evident proposition which stated more simply means that the best man would win.

Most important as the determining factor in unequalling otherwise equal things will this potentiality of personality become when we consider that the combatants on the sea will be of different nationalities. In the battle that will ensue, that ship, that navy, that nation with the more enlightened men, rather than with the heavier guns, will conquer. In his work "War on the Sea,"[1] Captain Darrieus states, referring to the Russian fleet at Tsushima, that "all this available material was good for nothing without a personnel capable of bringing out its value, that these ships represented only a virtual energy, if they lacked men able to put life into them, that finally had they been ten times as numerous, the Russians would still have been beaten because they did not have to any extent the most essential of all the elements that make up military strength—moral force."

Moral force means that mental condition as regards courage, zeal, hope, confidence and the like which impels men to fight. We have read of savages armed with spears hurling themselves, until the last man expired, against troops armed with firearms; and also of trained forces engaged where one contestant entered the fray with the conviction that he would be beaten because of inadequate preparation; a condition of affairs discreditable alike to contestant and country for there is no excuse for a nation, or a military man that neglects in time of peace to prepare for war.

A war has its inception far away from the scene of actual conflict and many preparatory steps have to be taken before a naval officer can be called on to dare all that may become a man. These premonitory symptoms, however, are forewarnings of the coming of events he must be prepared to meet, contend with, and control, in opposition to the will, power, and efforts of an equally foresighted enemy. And that one of the rivals who in training, learning, spirit is the better endowed, will, if other things be equal, the better serve his country.

In our endeavor to examine very broadly and generally into the question of the predominance of the human factor as the remain-

[1] Professor Alger's translation.

ing thing when perchance other things may be equal, we shall not mention the vexing topics of rank, promotion, command; neither will the divergent views of tactics be commented on, nor the particularities of strategy—all of which have been ably set forth by talented officers, in many volumes of the PROCEEDINGS. Instead, an effort will be made to bring into notice some of the well known major elements that underlie the practice of the naval profession, and the fundamentals that inhere in the life of an officer of the navy.

STRATEGY.

First as the most comprehensive and most potent of the larger essentials of the naval life, may be mentioned strategy, a high sounding word, yet all that writers tell of naval policies and programs of naval operations and constructions, is contained in that one word, "Strategy." It is defined and its meaning is explained, in *The Century Dictionary*, as follows:

"The science of combining and employing the means which the different branches of the art of war afford, for the purpose of forming projects of operations and of directing great military movements; the art of moving troops so as to be enabled either to dispense with a battle or to deliver one with the greatest advantage and with the most decisive results; generalship.

"In strategy three things demand especial consideration:

(1) the *base of operations*, or line from which an army commences its advance upon an enemy;

(2) the *objective*, or *objective point*, the point which it aims to possess, or the object which it strives to attain;

(3) the *line of operations*, or that line which an army must pass over to attain its objective point.

"When an army assumes a strictly defensive attitude, the base of operations becomes the *line of defense*, and in a retrograde movement the line of operations becomes the *line of retreat*. *Strategical points* are the points of operation of an army—namely, points whose occupation secures an undoubted advantage to the army holding them for offensive and defensive purposes, and points which it is the chief object of an army to attain. The *theater of operations* comprises the territory to be invaded or defended by an army. It includes the *base of operations*, the *objective point* the *front of operations*, the *lines of operations*, the *lines of communication*, which connect the several lines of operation, *obstacles*, natural or artificial, *lines of retreat*, and places of refuge. The *front of operations* is the length of the line in advance of the base of operations covered or occupied by an army."

By substituting the word "navy" for "army" in the above definition and explanation of strategy, the entire object of a navy will appear—its reason for being, its work, its mission. If it execute properly the above duties of its office, it will preserve inviolate the integrity of our country as expressed in the oath of allegiance which we men of the navy charged with this God given trust take—"to support and defend the Constitution of the United States against all enemies foreign and domestic."

Setting aside as much too vast and complex for present discussion so much of strategy as is bound up with national policies, diplomatic relations and foreign affairs, let us with the *Century's* definition in mind take under hasty examination that active tangible strategy to which the navy must be committed, for which it must be always preparing and by which it must be eternally swayed—the command of the sea.

The command of the sea does not necessarily imply that a nation in order to hold title to it must have the greatest number of protected guns afloat, that is the most numerous fleets of battleships. If it did, Britannia with her two power standard would rule the wave. Maybe she does; but no first-class power is willing to grant her superiority offhand. She will have to fight for it to prove it. The command of the sea as we are now looking at it, has to do with that objective of strategy which takes cognizance of the advantages that inhere in having at some decisive point in the theater of war a fleet superior in fighting ability to that of the enemy; in other words to the strategy of concentration.

Concentration is defined as "the state of being brought from several or all directions to a common point or center or into one mass or group." Our fleet concentrates every year at Hampton Roads and Guantanamo. It concentrated at New York the other day. During the Spanish War it concentrated at Key West and at Santiago. Where, in days to come, will the center be at which our fleets shall be grouped in such manner as will warrant the assumption that we shall be in that position which will nullify the strategy of an enemy?

The answer will depend on our conception of what the nature of our situation will impel an enemy to attempt. If we are satisfied that we hold a strategic point of determining importance which the enemy, if he hope to overpower us, must himself first

wrest from us, we conclude that he will endeavor to concentrate his forces there. We believe we hold such a point; therefore, whether our enemy come from the east or from the west, whether his ulterior objective be the conquest of our west or our east, the immediate purpose he must accomplish before he can hope to attain any definite end and which must be the controlling idea in shaping his strategy, must be, as we view the situation, the possession of, or the mastery of, the Panama Canal. Therefore must our fleets concentrate at that common center—whether near or far is not now in question—where they can safeguard that water-way and insure that its waters shall run unvexed from sea to sea.

The Panama Canal is an artificial channel 40 miles long connecting the Atlantic with the Pacific and through it a ship 900 feet long and 38 feet draft can comfortably pass. There is no likelihood that a man-of-war of larger dimensions will ever be built, for in addition to the dimensions imposed by the locks of the canal—1000 feet by 40 feet—there are the further limits set by the depth of water in the harbors where ships must go to be docked and to obtain the sinews of war—men, provisions, ammunition, equipment and other things indispensable in enabling them to carry on unembarrassed their business of fighting. As a man goes from his home to his office and returns after his day's work is done to recuperate and prepare for the work of the next day, so does a ship go from her home or base and return to it for health and strength. And as the man selects this home with a view to its proximity to his business, the means of transportation, the safety of the neighborhood and the nearness to the markets, so does that department charged with the well-being of fleets select for bases those places where the requisites for the life of the ships can be safely and conveniently procured in abundance. Evidently the nearer these bases are to the theater of war the better, for by so much can the squadrons reach their destination in less time and with less fatigue and expenditure of energy. Therefore must the geographical as well as the material and physical location of a port be taken into consideration when settling upon a base from which a fleet can go forth in full panoply to meet the enemy. This base of operations is the first of the three things in strategy demanding especial consideration, it is the point from which the fleet commences its advance upon an enemy.

THE BASE OF OPERATIONS.

In endeavoring to select for our bases of operations those harbors in which the fleets can be best maintained for conducting aggressive warfare, the possibility of an attack on them must be given careful consideration; for unless we can safeguard our own shores so adequately that an enemy will hesitate long before daring to approach them we cannot hope to be able to lead him to conduct his operations away from our immediate coast into waters of our own choosing. It is obvious that if he can lock up our fleet in one of its bases, he holds the key, and he can attack our coast when and where he pleases; and from that moment the canal will be his. Therefore does a consideration of the question of coast defence become of much consequence and call for some amplification, though to enter into a full discussion of the matter cannot here be undertaken.

The length of the coast line of the United States requiring naval defence, as given by our Hydrographic Office, is as follows:

	Naut. miles.	
United States Atlantic Coast	3175	
" " Pacific Coast; including Alaska	7625	10,800
Dependencies:		
Porto Rico	250	
Canal extremities	20	
Hawaiian Islands	778	
Midway Island	18	
Guam	200	
Philippine Islands	8800	
Tutuila and Manua Islands (Samoa)	69	10,135
Total nautical miles		20,935
Total statute miles		24,108

Excepting Great Britain whose coast line, including possessions is 30,000 miles long, no other country has nearly so long a line as we have; for instance, Japan's is only 6600 miles and Germany's, 4100 miles. The problem of protecting the littorals of Great Britain and the United States is, therefore, more serious and complicated than that which confronts those nations that have powerful navies and short coast lines; and it would be impossible of solution as regards our country were it not for the fact that nature has come to our assistance. There are miles and miles of our coast that cannot be approached near to because of

dangerous navigation; and there are miles and miles where an approach would further no end since nothing substantial or beneficial could be gained because of lack of supplies and facilities. On the other hand there are many desirable harbors where, could an enemy land, he would find all things needful; but these places are defended.

The standard of the sea defence of a port depends solely upon the armament and armor of the fleets that may attack it. The functions which this coast defence is capable of performing are of three kinds—so informs Colonel Sydenham Clarke of the English Royal Engineers:

1. To prevent the use of a harbor by an enemy for the purpose either of shelter or of landing troops.

2. To bar a harbor or channel of approach and exclude an enemy from the inner waters.

3. To prevent the bombardment of a dockyard, town or arsenal.

"Of the above No. 2 always includes No. 1; Nos. 2 and 3 may be combined, or No. 2 may practically include No. 3; No. 3 involves denial of adjacent waters to the enemy." The question which arises in considering the above functions is that of the positions it is necessary to defend having regard to the requirements of naval strategy and the local requirements.

In order that this question shall receive the careful consideration it deserves, the littoral of the United States is divided into several districts each one of which is under the supervision of a naval officer who reports on its facilities and who should study the situation of possible landing places and lay down the probable form and strength of an attack and the best way to meet it—the kind of vessel to be employed, the suitability of submarines, torpedo craft and other coast defence means, and the number and nature of the guns needed. Some parts of the coast require more protection than others and some because of local conditions require none at all.

What may be the details of the strategy of an enemy with respect to an attack on our ports is of course unknown to us, but he would undoubtedly be influenced by his information of the limitations imposed by our preparations and situation, which must be more or less accurately known to him. An attack on summer resorts, for instance, would lead nowhere and serve no purpose; nothing of benefit in the way of supplies or position

could be gained. But a threat against a large maritime city or the spacious estuaries where our greatest commercial activities are, would work havoc. The mere contemplation of such a possibility would demand instant recognition by our fleet; and our readiness to meet such situations convincingly and to concentrate our forces advantageously, will depend largely on the strategic positions of our bases of operation—on their military characteristics, their strength of offence and of defence; and these in turn are affected by the commercial, the topographical and the hydrographical features of the environment.

Our navy owns a number of navy yards and stations scattered along our sea board, and some of them are admirably placed to serve as bases from which to begin an advance upon an enemy. Such are New York, Norfolk, San Francisco and Bremerton. There are also first order advanced bases at Guantanamo and Pearl Harbor; and there are second order bases at Charleston, Key West, Olongapo, Philadelphia and elsewhere. In addition, we have coal depots at Narragansett Bay, San Diego, Manila and other places; and besides, some other stations like Portsmouth, New London, New Orleans, Pensacola, Port Royal, Samoa, of little use to the navy because of proximity to larger and better situated bases; and of inadequate facilities and protection.

"America," the Secretary of the Navy is reported to have said, "has twice as many dock yards as Great Britain, yet the navy of the United Kingdom is twice as large as that of the United States." He showed that we had eight first-class navy yards, three second-class, two naval stations, three training stations; besides a first-class yard in Hawaii, two second-class yards in the Philippines, and naval stations at Guantanamo, San Juan, Guam, and Tutuila. "In the early days of our navy," he said, "when the ship's motive power was sail, distances were not so easily traversed as to-day, and it therefore was probably necessary to have places for repair and refit of naval vessels more frequently along our coast than to-day. We have in all eleven first- and second-class navy yards, while Great Britain has but six of the same kind. Germany has three, and France five." None the less we continue to spend large sums of money to maintain yards that cannot receive and repair modern battleships. The Secretary has accordingly recommended that some of these yards and stations be abandoned and with this recommendation

the navy is in hearty agreement. There is a consensus of opinion that we should endeavor to have concentration of effort on shore so far as it may be compatible with concentration of effort afloat.

In these days of general diffusion of news, the compositions of fleets and their prospective movements can be well guessed at from the commencement of operations. We are, therefore, in a measure forewarned; and the enemy too. And each is aware of the objective of the other, though the preliminary strategical dispositions of each may be conjectural; in this respect honors are easy. But it may be otherwise if we consider our geographical position 3000 miles from the nearest over sea power on the east and 6000 miles on the west. Here we should be able to win, other things being equal, for we hold the interior positions. There is not a point on the Atlantic or the Pacific near the probable theater of war that cannot be reached by our fleets ahead of an enemy. Add to this advantage the physical restrictions imposed at many points by the conformation of our coast, and the meager resources at other points, and the question of the bases which it is necessary to provide having regard to the requirements of naval strategy, becomes a bit simplified. These requirements are securely protected ports of unlimited capacity near the centers of great commercial activities, close by the large and commodious estuaries where are the busy cities with their railroads and piers and docks and maritime interests, and in positions commanding easily the off-shore line of defence beyond the range of the guns of the fortifications, and so centrally located that interior lines are markedly theirs. Given these and easy navigation, and our bases of operation will meet our every wish. On the Atlantic the requirements are met by the navy yards at New York and Norfolk where the largest ships can be docked, repaired, even built so complete is their plant, so convenient and abundant every necessity, so obtainable material and skilled labor. Further they are perfectly safeguarded both by nature and coast defence from attack. No other ports on the Atlantic possess these desiderata to a similar extent. It follows then that if as strategic points they are equally eminent, they must be the best bases for our fleets. Let us see.

Suppose that we conduct a line of operations from our New York base, 200 miles to the eastward to the Nantucket lightship where all the European ocean-borne traffic converges. Within a day's run, of 400 miles at 17 knots, lie Halifax on the

north and Hatteras on the south. Within two days' run, 800 miles, lie Cape Race, Newfoundland, Bermuda and Bahama. Inside this New York-Nantucket-Halifax line, lie Portland, Boston, Narragansett Bay, Long Island Sound, New York and to all intents and purposes, Delaware Bay. The "wealth of Ormuz and of Ind" is here to tempt the bold to snatch at it. But that an enemy would appear in force in these waters protected as they are by our forts and watched over by our fleets, is incredible. His coming would certainly be announced long before he could accomplish or even hope to accomplish anything worth while. At most he might feint to attack, to divert our attention from his real objective, which, we take it, will be the Panama Canal.

About 200 miles to the southward of the New York base, lies our other first order Atlantic base—Norfolk, in equipment, facilities and operation nearly equal to New York with which it is closely connected by rail and water. Norfolk serves well as a point from which to conduct a line of operations to the southward of the New York line, and to observe the movements of an enemy from the Chesapeake to the entrance to Florida Straits. The salient along this stretch is Hatteras, 120 miles southward of the capes and 540 miles from Bermuda. Within a 500 mile radius are Boston, Nassau, Florida Straits and the ports between. The Chesapeake base controls the gateway to the capital and to Baltimore, and is as near the Delaware as is New York, thereby rendering doubly secure the opulent country surrounding the two main bases.

The distance from Hatteras to Halifax is 800 miles, and that from Nantucket to Nassau but a hundred miles longer, hence a fleet based on New York and one resting on the Chesapeake ought to be able to reach either extremity of the above lines of operation in two days, at 17 knots, and effect a junction. This disposition implies the possibility of a genuine attack on our Atlantic coast in the vicinity of our most extensive resources and greatest wealth; an attack so beset with dangers that no navy, unless it had already obtained command of the sea, would risk it and attempt to push it home. But as said before he might make a false attack.

When considering the determinants of strategy, the position of bases will be found to be restricted by the natural surroundings and the material resources of the encompassing land. Where the harbors are deep and large and well fortified and the con-

veniences of a metropolis are at hand, the position is ideal; the only remaining desideratum is proximity to the theater of war. This theater will be, we fancy, the Caribbean sea, about 1600 miles from our northern bases, a four days run at 17 knots. To carry on operations affecting the integrity of the canal from nearer bases would be easier and our lines of communication would be safer; accordingly we have established a base of operations at Guantanamo in the Caribbean, 1200 miles from New York.

Guantanamo is a deep, commodious harbor near the southeastern extremity of Cuba, about 60 miles from the Windward Passage, 400 miles from the Mona and 700 miles from the Virgins —the three main entrances to the Caribbean. Guantanamo lies distant from Martinique 850 miles; from Curaçao about 600 miles; and from the canal only 700 miles, a run of a day and three-quarters at 17 knots. If a circle be drawn from Guantanamo as a center and 700 miles as a radius, we shall see that within the circumference will lie the Florida Straits, Key West, the Bahamas, the three easterly passages to the Caribbean and finally to the westward, the Yucatan Channel, the only entrance from the Caribbean to the Gulf of Mexico. From a glance at the chart it will become evident that Guantanamo is well placed to serve as a naval base and that because of its position as a coign of vantage for observation and contemplated military operations, it possesses notable strategic prominence. From its safely guarded waters, a fleet can enter upon the theater of war in a shorter time and in a better state of preparedness than can an enemy entering from over sea; and from it our fleets can go out to the north or east or south, or through the canal to the west, and arrive at any strategic point along our coast before an enemy can. Guantanamo controls the canal; therefore must we make of it an advanced base of the first order.

The natural surroundings of Guantanamo, those pertaining to the normal conditions of the land and water features of the port are admittedly excellent, but the political environment is not so because the place lies in Cuba, a foreign country whose government is not powerful or stable, whose resources are not large and whose capabilities are not high. Whether the Cubans be friendly or not, they cannot be reckoned on as a people from whom valuable assistance may be expected, for even with the best intentions they have not the means. On the other hand if

inimical they would at the least be a thorn in the flesh; and they might, if so disposed, work incalculable mischief; for we must bear in mind that Cuba has other good harbors than Guantanamo where an enemy, despite international or neutrality laws or treaty stipulations, might effect a lodgement. Therefore, from entirely different reasons than those which necessitate the safeguarding of naval bases in the United States, must Guantanamo be made impregnable to attack from the land as well as from the sea.

It may be held that serious attack from landwards, omitting that which might perhaps come from the Cubans, is out of the question, because the preservation of the integrity of the surrounding sea rests primarily with our navy. So in truth it does: and so in truth it did in 1898 when we fought against Spain. None the less at that time, the Spanish squadron entered Santiago from Curaçao 600 miles distant without our fleet being a jot the wiser. Santiago was a fortified port strong enough on the sea front to restrict the movements of our investing fleets and to protect the fugitive squadron; and on the land front to resist attack from the Cuban forces and, for a time, from our large invading army. That Santiago was an unfortunate choice of base, lacking communication with supply centers, and wanting in resources and stores for army and navy, is not so much to be pointed out now as that Santiago in itself because it afforded safety was a good base. The deduction is obvious. Guantanamo, as said in the beginning, must be expanded into a fortress of the highest rank.

About 500 miles to the westward of Guantanamo and 70 miles north of Cuba lies Key West, right in the fairway of the Florida Straits, through which passes all the sea-borne commerce of the Gulf of Mexico. This island lies 50 miles from the mainland of Florida with which it is connected by a railroad built on the rocks and shoals between. It has always held a position of prominence and importance in the naval strategy of the West Indies, and during our war with Spain became so conspicuously useful and necessary that some naval officers have thought it would be forever after quite as desirable a base. Accordingly considerable enlargement of its plant, its facilities and its capacities resulted. Similarly, though to a less extent, was Tortugas, a small island 80 miles to the westward, developed; and the line connecting the two constituted a base line of operations, the western end leading to the Gulf and the Yucatan Passage, the eastern or Key West

end to the Florida Straits and the Bahama and Caribbean passes. The unsuitableness of Tortugas because of shallow water and ease of attack has been conceded and therefore its available plant has been moved to Guantanamo. As to Key West, the answer to the strategists who advocate its advantages as the base which can best conserve our interests as they are contained in the expressions the Monroe Doctrine and the Panama Canal, is found in the words of Admiral Stockton in a discusson of Commodore Beehler's argument in favor of Key West, as follows:

"Key West is a point that cannot be ignored; every war has forced it into a position of utility and value; but the inherent defects of the place as a harbor, as almost impossible of defence, have also become evident and made known its limitations. Its position as an advanced base has been strengthened by its future railway possibilities, but the weakness of this thread of communication, the great difficulty of preserving it intact in face of an active and strong navy shows also the limitation in that direction. Year by year the place becomes less valuable as a deep water harbor and as a place where prolonged repairs can be effected with that safety from attack which is so essential in modern times."[2]

Key West, therefore, if we accept the above argument, must always be maintained because of its strategical qualities as a *point d'appui;* but not as an advanced base of the first order, because of its poor harbor, insecure communication and inadequate fortifications. A base for its own safety must be self-contained, able to hold its own without the aid of the fleet—for the fleet must be foot free—and its defences must be fixed, assisted perhaps by torpedo-boats, submarines and other auxiliaries of the mobile coast defence. If a base, instead of being able to protect ships, needs to be protected by them, it changes from a source of strength into a source of weakness. Key West, however, is the key to the Gulf and, therefore, would have to be used in case the theater of war was the West Indies, as a secondary advanced base for the less powerful, but no less necessary units of the fleet, that would be on watch off the northern entrance of the Florida Straits and off the passes of the Bahamas, all lying within a 300 mile radius of that base; and off these fairways, these lookouts would come in touch with the patrol fleet based on Guantanamo and extending its beat from that base to Nassau 400 miles northwest, and also to the Virgins 700 miles east.

[2] U. S. NAVAL INSTITUTE PROCEEDINGS, No. 130, June, 1909. Discussion of "The Navy and Coast Defence," by Commodore W. H. Beehler, U. S. N. by Rear-Admiral C. H. Stockton, U. S. N.

From the above or some similar arrangement it would come about that the three patrol squadrons—that from Hatteras, that from Guantanamo and that from Key West, would get into touch to seaward off the Bahamas, and this contact would be transmitted north by the Chesapeake lookouts, and south by the patrol fleet based on Guantanamo and keeping vigil over the many entrances to the Caribbean—except the Yucatan Channel which passage being only 200 miles to the westward of Key West, can be more easily guarded by a patrol from that base.

Another secondary base is to be found at Charleston, especially intended, however, as a home port for torpedo craft; and for this purpose it is being expanded into a fully equipped depot. Charleston has good railway connection, the harbor is deep enough and is safe, and easily safeguarded from attack, as was abundantly proved during our Civil War; and the navy yard has a fresh water front; but the depth may have to be maintained by dredging. Its position is about 600 miles from Key West, 450 miles from the Chesapeake, and 850 miles from Guantanamo. As a resting place for the smaller units of the fleet, it holds a good position; from it the little craft which have not a large coal capacity or extensive sea-keeping qualities, can hurry away in prime condition by interior lines to some other strategic point nearer the theater of action.

Charleston possesses advantages as a home port in peace times, but it seems to me that after the war is on, these torpedo-boats would better have their places of rendezvous at Guantanamo, Porto Rico and Key West, handy to the main fleet. And perhaps it might be advisable to have some of them domiciled as it were at the canal entrances where to provide a suitable base for them appears to be an easy thing to do. I venture the further suggestion in this connection, that there ought to be installed under the guns of some of the fortifications in Panama Bay a complete coaling depot, where the big ships could fill their bunkers and renew their equipment; for the distances in the Pacific are much longer than those in the Atlantic, and the ports available by deep vessels for obtaining sustenance are few and far between. Therefore it becomes a matter of serious importance to start a line of operations in this western theater of action, with a full supply of all things needful, if we would make sure of arriving at our destination in the fittest possible condition.

There are 7600 miles of coast line in the Pacific, including Alaska, that belong to the United States proper; and at only two places along this stretch can our fleet find first order bases; these are San Francisco and Bremerton. San Francisco lies 3300 miles from Panama, or an eight and one-quarter days' run at 17 knots; and Bremerton lies 800 miles to the northward of San Francisco. Besides the above bases there is a coaling station of the first order—not a navy yard—at San Diego, 450 miles south of San Francisco, and 3000 miles north of Panama—seven and one-half days at 17 knots. In the event of war in the Pacific, the ultimate object of the enemy would be, I imagine, the same as in the Atlantic, that is the control of the Panama Canal and the consequent prevention of the joining together of the eastern and western fleets. And in the western waters as in the eastern, the preliminary operations of the enemy might take place off the American coast. To grasp quickly the significance of these early demonstrations of hostility, it would be necessary of course to get into distant touch with the enemy. Accordingly from our base at Bremerton a line of observation maintained by a squadron of fast cruisers would patrol as far as Unalaska. Based on San Francisco a second observation squadron would patrol to the southward to San Diego: a third would watch from San Diego to cover the Gulf of California and the Mexican coast to Acapulco; and a fourth squadron based on Panama would guard the way between the canal and Mexico. To overlook this long stretch of coast is a most difficult task for a fleet, well nigh impossible of successful accomplishment; fortunately, however, here as in the east, it is much simplified by the physical configuration of the coast and the nature of the region behind it both of which, the former because of dangerous navigation and the latter because of barrenness, are deterrents to an attack elsewhere than in the vicinity of the large cities near which are our great navy yards and stations and stout fixed coast defences.

Furthermore, and in a most important way, is this watch and ward of the Pacific littoral made less irksome by our ownership of an outpost at the Hawaiian Islands, 2000 miles from our western mainland, where stands the second of our first order advanced bases, Pearl Harbor, a sentinel near the center of the north Pacific Ocean. Pearl Harbor is distant from Bremerton 2400 miles; from San Francisco 2100 miles; from Panama 4600 miles. From the shores of the western Pacific it lies distant from

Yokohama 3500 miles; from China 4900 miles, and from Manila about 4800 miles. It is, therefore, about one-third nearer in distance to our mainland than to the western Pacific coast. It has a splendid harbor, excellent facilities, many conveniences and can maintain a large and powerful fleet in a high state of efficiency; and it is a first order fortress. Like Guantanamo, however, it must be supplied from the mainland.

To the westward of Pearl Harbor, 1200 miles distant, lies our smallest possession, Midway Island, an American cable relay station, athwart the great circle route connecting Japan and Hawaii. An advanced squadron of observation from Pearl Harbor might make some use of the cable facilities of Midway; but otherwise the place has no military value—no ports, no facilities, no protection. Here we rest for the present further discussion of bases and lines of operation for conducting war in a theater near to our mainland, and move onward, for still westward the course of our empire holds its way, and 2300 miles from Midway and 3300 from Pearl Harbor we reach Guam 1500 miles from Manila.

Guam, while possessing a good small harbor which can be defended, lies off the beaten track, 1200 miles off the entrance of San Bernardino Straits and 1300 miles from Japan. The question of the value of Guam to the navy, as a strategic point, turns, I think on the relative advantages of the place to those to be found at Manila and Olongapo. I fail to see how Guam can be made to serve as an efficient *point d'appui* like Key West, where fleets can form and on which operations can be based; it lies near no fairway; it is further from Manila than is Japan or Hong Kong, and from San Bernardino Straits than is Formosa. On the other hand, that Guam holds a position of strategic importance has been held by many "far wiser than I."

In the Philippines we have Manila, a fortified naval port, and Olongapo with its navy and dry dock. Perhaps a single station here at a central port would suffice for all naval needs and purposes. However, the present arrangement was evolved from long discussion and much argument of the strategic possibilities and probabilities, and it will remain until some other strategic board "after mature deliberation" reaches some other conclusion. In themselves these ports are good bases of operation; they can be protected and can supply the fleet; and are in position well placed for safe-guarding the interior waters of the archipelago. But

the Philippines are a long way off from the mainland of the United States, about 6000 miles, and approximately 4000 miles from Pearl Harbor. On the other hand, from Manila to Hong Kong is only some six hundred and odd miles, and to Japan the distance is a scant 1500 miles—facts which signify that as between our mainland or Pearl Harbor or Guam we do not possess interior lines, which facts we hope to bring out more clearly later on when discussing lines of operation.

Distances are dry reading, but none the less are they in many instances the factors which enter most insistently into all the problems of strategy wherein the selection of bases, the lines of operation and the objective are the three things being especially considered; for they show that when opposing fleets are bound for the same strategic point in the theater of war, that the fleet that can concentrate first at this point with the fixed determination of gaining its objective will, other things being equal, gain a decided advantage at the very beginning of hostilities. It is evident that as regards our position in the Orient and that held by some foreign powers, we do not hold interior lines, the Philippines, therefore, stand to fall, unless of course we have a fleet there the superior in strength of that of the enemy. But we cannot take it for granted that the conquest of the Philippines would be the final objective of a power at war with our country; for so soon as that became evident our fleets would go out across the Pacific to meet him, as the Baltic fleet went out to Japan, and the struggle for the command of the China sea would be on. Which signifies that if an opponent in the waters of our possessions hopes to win a permanent victory there, he must close the Panama Canal to the passage of our eastern or Atlantic fleet.

What will be the essence of the strategy to be developed? Or, in a more general sense, what will be the objective or objective point which a navy will aim to possess, or the object which it will strive to attain?

THE OBJECTIVE.

Many of the propositions of strategy are self-evident, applicable alike to land forces and sea forces; notably so those containing such fundamental doctrines as be first in the field and the fight, concentrate a superior force against an inferior one, divide the enemy and beat him in detail, preserve unbroken contact with bases. These truisms, and many more like them, are as old as

war itself whenever and wherever it has been waged, afloat or ashore, and neither the army nor the navy can change them or disregard them. But in the practical application of these elemental precepts of active strategy as they affect the conduct of war on the sea in contradistinction to war on the land, there are several particulars in which the analogy between naval and army activities may be pushed too far. An army invades territory, holds it, defends it; a navy goes to sea, gets command of it, but can never own it, or hold it or do aught to it beyond move over it. Land is tangible, water intangible: land has ownership, positive, definite, and contains succor and shelter: the sea is free to all, contains no sustenance and the wind bloweth where it listeth; here on the sea is a fair field and no favors. In short, so far as the sea itself affects strategy, or tactics, things are equal, the same to both friend and foe. Therefore, to this extent, no more, is the navy less hampered than the army in formulating strategic plans for the attainment of its objective.

The objective of the navy, that which it should strive to attain, is, as said before, the command of the sea; and this command can be attained only by having a fleet superior to the enemy, at a certain point at a certain time and in such a state of preparedness that in the ensuing battle our opponent shall be annihilated. Where will this encounter take place? That is, where shall our fleet be concentrated? Shall it be on our own coast, or on the enemy's, or somewhere between? Near our bases or near his or out in the open? The questions may be differently put. Is the war to be a defensive one, or an offensive one, or a defensive-offensive one? If the first, it signifies that our forces will await near the protection of our home bases, the coming of the enemy whether the time of that coming be long or short. This defensive attitude must be the governing principle of the strategy adopted by a nation confessedly weak in sea power and constrained perforce to rely on winning a victory by achievements in which the land forces and the harbor defences must play a part. This kind of strategy may also be the policy accepted by a timid government and people, reluctant to imperil the safety of their ports by permitting the fleet, even though this fleet be a powerful one, to go far from the shores. Command of the sea can rarely thus be won. Instead of this stay-at-home policy, the idea should obtain that the defensive is assumed only for the sake of preparing to pass from it at the opportune moment to the offensive, when a

vigorous forcing of the issue may bring a victory. This is the essence of the strategy of the defensive-offensive that has often been resorted to by one of the parties to the fight and that has usually been attended with success.

Not infrequently a nation stronger on the sea than its adversary assumes, at the beginning of hostilities, an apparent defensive strategy because of its geographical situation, the nature of the war to be waged and the final result the government wishes to obtain. Our country awaited in and near our ports, the coming of the Spanish squadron. Similarly the Japanese awaited the coming of the Russian fleets; though both America and Japan declared the wars, were the aggressors, and held in view as their objective the destruction of the enemy's fleets in waters contiguous to their own, so that their armies might be safely landed on the enemies' soil and conduct there in security their campaigns undisturbed by the fear of being cut off from their own over-sea resources. Only by destroying the enemies' fleets, or its equivalent, can such protection be assured; and that both America and Japan would pass from the defensive to the offensive to attain this objective, fighting for it for all they were worth, was as well understood abroad as at home.

That this defensive-offensive strategy will be the naval policy of our government in the future when east is west and west is east and only the canal between and we have far distant over-sea possessions to protect, is a matter that cannot be settled off hand; everything will depend on who the enemy is. For, other things being equal, the remaining thing, victory, is more likely to perch upon the banners of that nation that carries the "war into Africa" that seeks its objective in the waters of the enemy; that is, of that nation whose strategy is founded on the principles of the offensive. Offensive strategy may be briefly explained by the statement that it signifies the moving of one's own sea frontier over against that of the enemy. Nelson frequently pursued this offensive strategy, also Admiral Farragut; and it was that of Admiral Dewey at Manila.

When engaged at war with a nearby state or when the distance separating the contestants is not beyond the radius of effective operations of a fleet depending for support on a base not remote from the theater of action, the strategy of the offensive ought certainly to be the controlling strategy of the war. But it may not be so when the road leading to the enemy is long and tedious

and beset with many uncertainties and complexities. Undoubtedly the strain of preserving intact the Russian fleet on its long voyage from Russia to Japan, so as to insure its safe arrival off Japan, impaired the efficiency of the Admiral and the personnel as well as that of the material: and the same can be said of the Spanish squadron from Spain to Santiago. To arrive at the theater of war tired, worn out both in men and material, and in this condition to give battle is to insure defeat. An offensive like this is really no offensive and the word spells only ruin. Not so was the offensive of Nelson and his fleet who could, if need be, sail from "Dan to Beersheba and back again" and fight with as much vehemence as though but yesterday from port.

A fleet on the offensive when the war is to be carried on over against the coast of an opponent, has at its command for attaining its ends four methods which our Admiral Sampson in discussing the coast defence of the United States stated, may be conveniently divided as follows: Attack on commerce: Blockade: Bombardment: Invasion.

The method of attaining the objective by an attack on the sea-borne commerce of an enemy has an attractive appearance because it employs that kind of strategy which rests on the supposition that much injury can be inflicted on the carrying trade on which a nation depends for sustenance, without at the same time endangering the safety of the fleet intrusted with the destruction of this sea-borne commerce. An attack on commerce necessitates the posting of a considerable force near the entrances to those narrow water-ways and restricted seas towards which lines of sea traffic converge, and to intercept there the stately ships as they are going on to their havens under the hill. Conceivably for a time such a stoppage of the commerce of Great Britain might prove annoying to her, but that it could last long enough to cause much scarcity of food is not thought possible though there might be some diversion of trade and some derangement of business; for sooner or later an English fleet would be out on the sea not only to convoy her merchant ships but also to bring to book the molesters of her trade.

An attack on commerce implies a defence of commerce. Two merchant flags out flaunt all others on the sea to-day—the English and the German. England is building battleship-cruisers of 28,000 tons, mounting 12- and 13½-inch guns, carrying fuel to steam to the uttermost part of the world, and speeding at the rate

of 26 to 28 knots—a knot or two faster than her own swiftest Atlantic greyhounds. Germany is following suit but has not yet equalled in numbers, size and power the English construction; and Japan is about to enter the lists. The building programs of other nations do not lead to the belief that the battleship cruiser is a favorite type, even with those powers who, in other days, were the exponents of that strategy known as *guerre de course*.

A war of chase has in times past had much influence in determining the naval strategy of France; and in some of its aspects it does appear commendable, as when a nation owns many remote dependencies and colonies with which it carries on an extensive trade. But to seek and not to find is of daily occurrence on the sea and blockades have always been run. However, in any naval war, commerce must suffer from those causes which are common to war itself and which cannot be escaped from by friend or foe. Such are increased cost of maintenance, expensive insurance, higher wages, fewer seamen; also the stoppage of commercial activities connected with maritime trade, and the chartering of vessels to the navy. All these disturbances disorganize and proscribe the business of the sea, and therefore it comes about that when peace returns the old order will be changed.

Our merchant marine never revived after the Civil War because the opening of the west by the railroads gave opportunity to men to earn a more natural and agreeable living on shore than a life on the ocean wave. This is the situation now, and although it does not perhaps pertain to strategy, yet is it important; even had we the merchant fleet we have not the men to man it. The point to be noticed here, however, is not the scarcity of seamen, but that in the constitution of our navy to-day, a war against commerce is not taken into account as a probable objective. "In so far as this [a war of chase] is one means to a general end," writes Mahan in "Sea Power," "and is based on a navy otherwise powerful, it is well. . . . It is not the taking of indvidual ships or convoys . . . that strikes down the money power of a nation; it is the possession of that overbearing power on the sea which drives the enemy's flag from it."

Blockade is defined as "the shutting up of a place, particularly a port, harbor, or line of coast, by hostile ships, so as to stop all ingress or egress and to hinder the entrance of provisions, ammunition or reinforcements."[1] Blockade partakes of the nature of

[1] *The Century Dictionary.*

commerce destroying, differing from it only in particulars; in the one case the fleet goes forth in search of commerce, in the other the fleet, practically at a standstill awaits its coming. Blockade under favorable conditions becomes a very effective objective depending, however, for its successful accomplishment on the improbability of a derangement of its plans of operation postulated on the two certainties that the enemy has not a fleet of sufficient strength to drive the blockaders off and that he depends on extraneous means for his subsistence. The most notable example of a successful recourse to the blockade as the objective of strategy is found in the shutting up of the ports of the confederacy during our Civil War. During the Spanish War Cuba was blockaded, but in this instance the aim seems to have been to shut in or out warships rather than merchant ships, though the latter were of course as carefully excluded as possible.

"The object of a blockade," wrote Admiral Sampson nearly ten years before he himself was called on to assume the responsibility of instituting and maintaining one, "may be to close a port that contains an important dockyard and prevent access to it by your own ships; or it may be to confine within the port our own armed vessels that may have assembled there; or it may be for the purpose of interrupting and destroying the commerce of the port." Of the last purpose we have already expressed an opinion. Excepting in rare instances it can be reckoned only as a means, not an end. Of the first object given above, to close an important dockyard and prevent access to it, it can also be said that perhaps it purports to be a means rather than an end, though here the aim to debar an enemy from returning to the support of his own bases and to destroy his efficiency by closing his own ports to him is one that an assailant of preponderating force might undertake if he wish to conserve his strength and expend but little of his energy, and is, furthermore, sure of the movements of his opponent. For example, a fleet might be coaxed away from its base by some ruse, or it might be away looking for its enemy, who in the meantime has slipped in off the harbor to which the other fleet is obliged to return. Something of this kind might have happened as the result of the Russian sorties from Port Arthur and Vladivostok, for the Japanese had additional superior fleets on watch off Tsushima. Unless the blockading fleet is much stronger than the fleet it seeks to exclude, the latter will force the fighting

and drive the former to within the range of the shore batteries and thus place it between two fires.

A blockade to keep an enemy outside his own ports and prevent his entering is the opposite of a blockade to keep him inside and prevent his leaving which is the second objective of a blockade mentioned above. Bearing in mind that the admiral was writing of the coast defence of the United States, we again quote his words: "A blockade . . . may be to confine within the port our own armed vessels that have assembled there." This is precisely the problem solved by the admiral at Santiago, except that the imaginary situation was reversed in the real—it was to confine within the port the enemy's armed vessels that had assembled there. In the harbor of Santiago the Spanish squadron was blockaded by a vastly superior American fleet well found in all those military respects in which the Spanish fleet was wofully lacking. Necessarily the strategy of the campaign was a success; our troops were landed; the Spanish squadron was destroyed, and Cuba fell. Blockading did it, and nothing else. Blockading was likewise employed by the Japanese and for the same purpose as by the Americans—to confine the enemy's fleet in port while the army was being landed; that is, blockade was adopted for the purpose of securing the uninterrupted movement of land forces—for invasion. Both the Japanese and the American blockades might have been forced by a fleet with the stomach to fight. In a sortie from Port Arthur the Russians out manœuvered the Japanese and had the game in their own hands but lost all the tricks; and the last of Cervera's ships fell only after a stern chase of 50 miles.

A difference is to be noticed between the arrangements made by the Americans and the Japanese for maintaining the effectiveness of their blockades. In the former the investment was by the entire fleet—battleships, cruisers, torpedo-boats, converted yachts, disposed in a cordon in full sight of the shore batteries of the enemy: near by was a base at Guantanamo, to which the ships repaired one at a time for equipment. In the latter the Japanese fleet was based on the Elliott Islands 60 miles distant from Port Arthur and off them the major units were concentrated, screened by a fleet of torpedo craft and cruisers stationed off the harbor entrance where the blockade ships could plainly see them. In the method adopted by the Americans the permanent shutting up of the enemy in his own port, emphasized by the sinking of the

Merrimac, was the objective of the blockade. In the method adopted by the Japanese the exit of the Russians was apparently looked for and they could then have been finally disposed of on the sea. The attempt at blockading the harbor of Port Arthur by sinking ships at the entrance was not made until later in the war when the Baltic fleet was en route.

The plans of both America and Japan for sealing a harbor with sunken ships miscarried—perhaps they always will: circumstances, however, govern cases. The procedure of the American fleet was the best possible to achieve the naval purpose of the campaign—the complete paralysis of the Spanish forces by a visible exhibition of preponderating naval power; for the two military arms of the two belligerents, the navy and the army of the United States and the navy and the army of Spain, were conterminous. This was not the situation that confronted the Japanese at the outset of hostilities; their army was landed on a neutral soil far away from Port Arthur and at a time when there could be no conjunction of the army and navy of either contestant. To conduct a blockade so that the blockaded will be encouraged to force it and appear in the open and there be met and fought to a finish was the strategy of Nelson, whose one idea when near the French fleet was to get at it and destroy it; for so long as it remained intact in port it was more or less of a menace and necessitated the presence of a fleet whose services might be needed elsewhere.

Bombardment as an objective of a navy is permissible when the demoralization of a people is desired and the demolition of defences is demanded to strike such terror in a government as will compel it to yield. Against defenseless towns bombardment is regarded as unnecessary, cruel, inhuman, but against defended ports, especially those protected by sea fortifications, it has frequently been resorted to to destroy their military efficiency and render them unfit and unsafe for occupancy by the native fleet that might hope to use them as bases. As a side issue perhaps, bombardment might be resorted to as ancillary to some other objective like blockade or invasion; a fleet, en route, might strike at a line of fixed communication or a poorly guarded station or depot, to cripple its equipment. Again, bombardment might be used to compel a squadron seeking safety under the guns of the land, to show itself; the American fleet bombarded San Juan with this object. In the above instances, and in many similar

ones, the attack of the fleet on the land is not made with the intention of permanently occupying the land or reducing its defences so that an army can be put ashore, for such a final objective of bombardment can only follow after the power of the enemy's fleet has been nullified. But a town might be bombarded even when it offers no visible defence, if under the consternation and fear incited by falling shots, an army might be quietly landed. And further bombardment might be employed as a threat to force compliance with a demand for indemnity: also as a punitive measure. In these instances, where unfortified places are to be attacked, notice of bombardment ought to be given if possible, so that the inhabitants may move away out of danger.

The expediency of resorting to bombardment as a method of subjugation is doubtful, for the expenditure of ammunition is incommensurate with the damage done. Generally the threat is quite as efficacious as the execution. At Manila after the destruction of the Spanish fleet, the town remained quiescent under the guns of Dewey's ships. Elsewhere during the Spanish War nothing worth the telling was accomplished by bombardment. At Matanzas, Cabañas, San Juan, even at Santiago, no damage was done to the fortifications and nothing was gained by the fleet. But we must not, therefore, conclude that bombardment is not a good strategic method of attaining an objective. Under cover of bombardment Farragut ran the forts at Mobile, New Orleans, Vicksburg. And Italy landed her forces at Tripoli. But in these operations and in nearly all others like them, the navy has usually had as the distinct objective of bombardments the clearing the way for the untroubled landing of the army; that is, for invasion.

If by the word invasion we understand it to mean "the ability to invade, to make a landing safely in an enemy's country," then is invasion the elemental concept of all military strategy; for if you find that your opponent's coasts are unprotected, his commerce unguarded, his harbors unlocked and all such things at the mercy of your guns, it must be obvious that his fleets no longer exist and that his fate lies in your hands to do with him as you please. To be in a position to make a landing safely in an enemy's country, the road leading to that country must first be cleared of possible obstructions and then kept clear. To secure this right of way beyond the shadow of a doubt, your enemy's sea power must be reduced to impotency and his defences at the

ports of debarkation must be silenced. These offensive measures having been successfully carried out by the navy, the army can be transported to the enemy's country, landed safely, and the further prosecution of the war be entrusted to the land forces; for with the actual putting of one's foot on shore and invading his territory by marching over it and fighting for its possession, the navy has nothing to do.

There have been many occasions on which fleets and single ships have landed their naval brigades as artillery and infantry, and invaded foreign territory as, for instance, at Sumatra, China, the West Indies, and at several Central American and other ports. But these invasions were not made for the purpose of capturing property; they were made for the purpose of protecting American interests from the predatory hands of revolutionists; they were forceful threats of what might follow from a disregard of the rights of neutrals; and upon the restoration of order, the brigades have returned quietly to their ships. Such operations the navy is constantly undertaking in countries with which we are in no sense at war; and are not analogous to the bellicose movements with which strategy is concerned, but are made with the connivance of a government to assist its efforts to preserve order. The invasion contemplated by strategy is the ability to occupy or control the soil of a foreign power in opposition to that power's efforts to prevent it. After this opposition has been overcome by the navy, the actual holding of the land devolves upon the army brought there by the navy.

A blockade if it can succeed in confining irreversibly an enemy's fleet within a port may be resorted to as a means of protecting the landing of troops; and bombardment, too, may be, as it often has been, effectively employed for the same purpose. From which it might be deduced that the objective of naval strategy might perhaps be blockade or bombardment as it was in our Civil War. Not so, however, for in that war there was no fleet or semblance of one in opposition. In recent wars both blockade and bombardment were resorted to only as a means to attain the real strategic end which was invasion in the face of naval opposition. And although this end was attained for all purposes before the destruction of the enemy's fleet, yet was it not in reality an uncontrovertible fact until after that fleet had been destroyed. The objective, therefore, whether it be sought by means of commerce destroying, blockade, bombardment or invasion, is in the last

analysis the destruction of the enemy's fleet; and this destruction should follow as the result of the successful conduct of a line of operations, that third thing in strategy demanding especial consideration.

THE LINE OF OPERATIONS.

In time of peace we prepare for war. In the security of our offices we engage in mimic warfare; we place an enemy now here now there, and conduct imaginary operations against him using known quantities like his strength in ships, the location of his bases, his military resources; and the unknown ones like his base of operations, his line of operations, his objective. Hence follow two kinds of strategy—the theoretical and the practical. The former selects bases, studies situations, arranges programs, anticipating coming events; the latter unfolds as the strategy of the enemy becomes apparent, and is altered from time to time to conform to the needs of the occasion. But the known factors cannot be eliminated from the active war problem for the latter depends for solution on the fixed principles of the science of strategy which determine unalterably what means shall be always at hand for putting into practical effect this or that line of operations.

The line of operations is that line over which a fleet must pass to effect concentration; and since it is liable to attack, great care must be taken not to be led astray from the straight path leading to that end. There must be a rigorous holding to the specific object in view—to reach the enemy in the quickest time and in the best position to fight him. Nelson led his fleet from the Mediterranean to the West Indies and back again in search of the French fleet: there was no dalliance with other interests, no running after false gods, his one objective was his enemy's fleet. And although he operated on unusually long lines yet he arrived at the front of operations "fit for a frolic or a fight." There is no need to state that if a line of operations is so long and hazardous as to cause exhaustion by the time the front of operations is reached, it serves no good purpose.

The line of operations is the possible fighting line, the front of operations is the actual fighting line. It may happen that the line of operations and the front of operations run parallel or coincide, they often do; and they can never be divorced in considering naval strategic movements. The front of operations may

be defined as the length of the line covered or occupied by the fleet after the enemy has been located. It signifies the final strategic disposition of the fleet before it enters upon the domain of tactics. The strategy of the front of operations like that of the line of operations falls under the purview of the strategic board, but the execution of the plans even to the extent of changing them must be largely entrusted to the judgment of the commander of the fleet, who, being so much nearer the scene of operations, can with a clearer eye more fully discern the advisability of pursuing this or that plan of action. He knows best the efficiency of the units of his squadrons, what ships have foul bottoms, or defective machinery or insufficient equipment or sick crews. And he can often foresee movements of the enemy which from their nature cannot be known to the strategic board. It should be recognized that in a large measure he has forced upon him by circumstances the responsibility of the active conduct of the war; and, therefore, when he brings his fleet to the front of operations he should be permitted to regulate matters to suit himself so long as they may be in consonance with the general plan of the campaign "so true is it that one man and one intellect properly qualified for a particular undertaking is a host in itself," as was said of Archimedes at the defence of Syracuse.

The front of operations cannot be carried beyond half the steaming distance of the least efficient vessel of a fleet. That is, if this vessel because of excessive fuel consumption or weak boilers or poor coal, has a radius of only 4000 miles, her effective power as a fighting ship would limit the front of operations of the whole fleet to a range of half this distance or 2000 miles, even if the other ships could go twice this distance. Steaming efficiency is an element of great importance in preparing strategic plans for conducting war in the waters of distant possessions. Dewey's line and front of operations led him into Manila Bay where with his tactics he gained his objective, the destruction of the Spanish fleet. Further operations he could not engage in because his nearest base was beyond the reach of some of the units of his fleet. That having utterly ruined Spain's sea power in the Orient, he had attained his objective and there was, therefore, no other line of operations for his fleet, is not to be pointed out in this connection; but that he was virtually tied to Manila until assistance reached him. Here becomes apparent the value

of Pearl Harbor as a strategic point on which to base a line of operations in the Pacific.

In the event of war in the Philippines the line of operations would extend across the northern entrance to the China Sea and connect to seaward off Cape Engaño with a line stretching up from San Bernardino Straits. Maybe this line of operations might have to be triangular—from the straits to Guam to Cape Engaño. But unless our fleet be very strong relatively to the enemy's, Guam might as well be left to itself. I think the front of operations would be off the west coast of Luzon, Manila being the objective, and the proceedings quite like Admiral Dewey's, his way being the shortest, safest and easiest. Manila fallen, the victor might perhaps pass on out through San Bernardino Straits, stop for a moment at Guam and then proceed at slow speed across the Pacific towards Panama.

Here again Pearl Harbor rises like a tower of strength near the center of this trans-Pacific route. If he can pass by without being badly damaged, well and good, he stands a chance to reach the canal. This movement across the Pacific presupposes the destruction of our Philippine fleet, a not altogether unthinkable catastrophe; for interior lines as pointed out elsewhere are held by the English, Chinese and Japanese, and neither one of them would be so foolhardy as to conduct a line of operations in distant waters while a powerful fleet in being remained in his rear. But to make us sure of holding the Philippines our fleet there would have to be much strengthened; and to do this might necessitate the weakening of our force elsewhere at a time that might be inconvenient for consummating the designs of the campaign. However, the Philippines are ours for better for worse, and must therefore be safeguarded. That they will be a cause of constant anxiety from a naval strategic point of view whensoever, wheresoever and with whomsoever we may go to war, we cannot prevent.

In respect to our American coast, Pearl Harbor stands on the outer line of defence. Were an enemy to get inside it, he would be between two fires, for from our mainland bases and from Hawaii we could reach him by short lines of operation. If Panama be the objective, we shall have to extend our lines, and of course, the enemy will have to lengthen his: but Pearl Harbor is only 4600 miles from the canal while Japan is 8000 miles; we, therefore, in the race have a double advantage over him; and

when we recall that we have a fleet awaiting him in the Caribbean we find we have him here also between two fires.

Before quitting the Pacific lines of operation, a few words must be submitted concerning our far removed unfortified possessions in Samoa-Tutuila and Manua Islands. They lie in the south Pacific distant about 4500 miles from the Philippines and the Japanese shores; some 3100 miles from Guam; about 2300 miles south of Pearl Harbor; and nearly 6000 miles from Panama. Close alongside them and in the same group are two other islands that belong to Germany. Samoa has no natural facilities for assembling a fleet and no material resources for assisting one; excepting coal our fleet could not be provided with anything. I, therefore, venture the suggestion that these Samoan possessions of ours possess little strategic value. What with out Pacific mainland, our Hawaiian Islands, our Philippine group, our Panama Bay, to say nothing of Guam and northwest Alaska, our hands are pretty full without the addition of Samoa. If we look at the chart we shall see that if we sought to protect it adequately we would be jeopardizing the safety and welfare of our other possessions and shores that are much nearer and dearer.

In connection with what has been said above and also with some remarks submitted under the "Front of Operations," is the implication that a fleet is limited in its ability to concentrate at a distant theater of war by the circumference of a circle described from a base as a center and with a radius equal to half the full steaming distance of the least efficient unit of the fleet. This inference needs to be somewhat qualified, for while it holds in the abstract it does not always in the concrete. For instance, the *Oregon* and the *Marietta* from the Pacific, reached the front of operations in the Caribbean by coaling en route at neutral ports: the Russian Baltic fleet made as long a voyage under much more trying circumstances, and was able to reach the front of operations with so much coal on board that the armor belts of some of the ships were submerged. On the other hand, the Spanish squadron arrived at Santiago with bunkers empty, having been unable to fill them at Martinique or Curaçao, a condition of exhaustion, however, which may be attributed to the remissness of the Spanish home authorities in failing to make proper arrangements for supplying fuel and other requisites of efficiency: consequently was the mobility of the squadron so impaired that the

ships had to seek the most convenient harbor at hand, and remain there impounded.

To provide against such impotency and to permit of the extension of a line of operations, fleets have to-day as essential parts of their organization, a number of auxiliary non-combatant vessels such as colliers, repair ships, tank vessels, and others to accompany the fighting force on its voyage and supply it with all the things it may need. We must bear in mind, however, that an auxiliary can only accompany the fleet for a distance equal to half her full steaming radius—unless she be towed—for she must retain enough fuel to insure her easy and safe return to her own base. Again, the speed of the auxiliary is that of the slowest ship; and again, coaling ship at sea is slow work and delays the movements of the fleet. Auxiliaries are necessary; fleets to-day cannot maintain their position without them; yet they may be harmful, for if the fleet be attacked while encumbered with them, they may have to be protected. Auxiliaries were taken to the front of operations at Tsushima. In this particular instance their presence did not, perhaps, have any effect on the result, but undoubtedly the tactical formation of the Russian fleet as it came up to the front had their protection in view. Whenever circumstances permit it to be done, a fleet making passage ought to resort to its auxiliaries to fill every need, supply every want, satisfy every desire. Then, freed of its impediments, it ought to be ready and anxious to meet its opponent, so that only the brain of man shall stand between it and victory. Whereabouts will this final encounter take place? In other words where, when all other things are supposedly equal, will the remaining thing, the battle of the wits be engaged in?

THE THEATER OF OPERATIONS.

Many years before the building of the Panama Canal was begun, Admiral Mahan wrote in "Sea Power" somewhat as follows: "If the canal be made, the Caribbean will be changed from a terminus and a place of local traffic into one of the great highways of the world. Along this path a great commerce will travel, bringing the interests of other great nations, the European nations, close along our shores, as they have never been before. With this it will not be so easy as heretofore to stand aloof from international complications. The position of the United States with reference to this route will resemble that of England to the

Channel and of the Mediterranean to the Suez route. As regards influence and control over it, depending upon geographical position, it is of course plain that the center of the national power, the permanent base, is much nearer than that of other great nations. The positions now or hereafter occupied by them on island or mainland, however strong, will be but outposts of their power." Long after this was written and long before the site of the canal had been selected, the United States engaged in a war against Spain in which the Caribbean was the theater of operations and in which the positions of the contending powers and the situation in general, reviewed as a whole, were not dissimilar to those forecasted by Mahan, nor unlike those which the future may reasonably be expected to bring forth, but in a more marked and emphatic manner. It seems well, therefore, to look once again and this time more carefully than before, at this stage whereon we are destined to play a great part.

The Caribbean Sea has been thus described: "This grandest inlet of the western hemisphere—corresponding in several respects to the Mediterranean—is separated from the Gulf of Mexico by Yucatan, and from the Atlantic Ocean by the great arch of the Antilles, between Cuba and Trinidad inclusive, stretching in north latitude from about 8° to about 22°, and in west longitude from about 61° to about 89°."[1] In that both Mediterranean and Caribbean lead to great canals through which enormous volumes of commerce must pass and that both have been and probably will again be the theaters of war, the likeness between the two is evident. The dissimilarity between them lies in the important fact that the Mediterranean can be entered by but a single natural gateway, the Straits of Gibraltar, whereas the Caribbean is connected with the adjacent ocean by many passes through which deep draft ships can safely steer. One powerful state, Great Britain, holds the fairway into the Mediterranean under her guns at Gibraltar that synonym of strength, whereas several states, some of the first rank, hold the command of the different passes into the Caribbean.

The stones of which the great arch of the Antilles is built belong to divers nations. Great Britain owns thirteen or more; among the most important, Jamaica, Barbados, and St. Lucia. France possesses Guadaloupe, Martinique and others. The

[1] Encyclopedia.

Dutch occupy the Curaçaos—though since they lie in the southern part of the sea well inside the other stones, they perhaps do not form a component part of the arch. Denmark holds title to the Virgins at the northeast bend of the arch. Over against them lies our Porto Rican territory. Next is Haiti and San Domingo, an independent island belonging to two colored republics; and next comes Cuba, also independent, but really under the suzerainty of the United States. This completes the great arch that separates the sea from the ocean. On the south the boundaries of this grandest inlet of the western hemisphere are Venezuela and Colombia. Then comes Panama with its territory cut in two by a ten mile wide ribbon of land of American ownership through the center of which runs the thread of the great canal. Next along this western littoral comes Central America, topped off by the conspicuous Mexican promontory of Yucatan.

Distinguished because of the absence of any national foothold along the shores of this Caribbean Sea, is that mighty, forward, warlike state Germany; crowded at home, needing an outlet abroad and desirous of securing one. Many Germans are to-day domiciled in Central and South America and in the Antilles, and are carrying on unobtrusively a lucrative and expanding business. All of which state of affairs are significant facts to be taken into consideration in shaping national policies and formulating military programs.

When selecting strategic points the occupancy of which will be of advantage to the nation holding them for conducting warlike operations, both the ethnographic and geographic features of the surroundings must receive due consideration. It is manifestly less annoying to have near our fixed positions, a weak and insignificant people with whom war would be impossible, than to have as neighbors a strong, aggressive nation with whom we might possibly be at sword's point. Nearest our Caribbean base, Guantanamo, are the Haitians on the east, and the English in Jamaica on the south. Nearest the canal, of the great states is still England in Jamaica. At Porto Rico near the salient of the arch of the Antilles we have Denmark on the right and Haiti on the left. Over along the other sea-boards sit nations whose navies have not been at all developed and whose forces for operating in the Yucatan Passage and about the canal are negligible.

In the above roughly sketched outlines of the Caribbean theater of operations and its environment we have, as it were before us, the scenery and the setting of the stage and the entrances and exits through which the actors can come on and go off as they play their several parts. The theater is a large one, but not large enough for two rival troops to hold the boards at one and the same time: a fight must result from any such attempt; and either the one company or the other must be left in undisputed possession. Stating this cold fact less dramatically, we may say that the "theater of operations comprises the territory to be invaded or defended by an enemy."

Pertaining to the theater of war and the three especial things of strategy we have been considering, are several other things; notably the lines of communication which bind together into an harmonious whole all parts afloat and ashore—the strategy board, the fleet, the government, so that there shall be that coördination of efforts which will make for an intelligent conduct of the campaign. Despatch and supply vessels must be free to come and go between fleet and base, and cable and wireless telegraphs must be secure from interruption. The wireless is the most important means of quick communication thus far developed, and it was successfully used by the Japanese; but the Russians could have stopped it had they known how: perhaps in the future the system will be improved so that messages can pass without fear of disturbance. Also in the future may come the wireless telephone; and near at hand is the aeroplane. It can move with great rapidity—60 or 70 miles the hour. Of the value of the aviator as a scout I am skeptical. He can be seen as far as he can see and be shot at by other fliers, and by guns and small arms. As a messenger he may also become a target, but he will then be on the inside lines under the protection of his own fleet. If, however, the aeroplane is to be developed into an efficient offensive weapon, then I take it, flier will meet flier and the battle in the clouds might be magnificent but it would not be war. Of course, if only one belligerent have flying machines, the advantages to him may under some conditions be very great—the Italians used them effectively against the Turks—but as a rule as soon as one navy adopts a means of offence or defence every other navy hastens to provide similar means; the only unchanging but always differing element common alike to all navies, is the human element.

Also pertaining to the theater of war though less important than lines of communication, is the proximity of harbors of refuge to which ships might retreat for shelter and protection because of some accident. Many such ports are found in the West Indies but, excepting one, they are not located uncomfortably near our own great base Guantanamo. That one exception is Jamaica, 100 miles south of, and opposite to Guantanamo and our main water-way between the canal and home base—the Windward Passage. Nature has here, however, as at Bermuda, Nassau, St. Lucia with its frowning heights, and at all other West Indian ports, interposed in the matter of distance from home, area, depth and protection. If Jamaica could be made a first order base it, and not Guantanamo, would be the key to the canal; but Jamaica lies 4000 miles from England.

In days of old when warriors bold commanded sailing ships mounting smooth-bore guns, there were no such restrictions imposed by size of ship and power of gun on depth of channel and protection of port as are to-day imposed by drafts of 28 feet and guns of 14 inches. The old hearts of oak were at the mercy of wind and wave and when the elements were unkind the port of refuge was sought. To-day we steam into or out of port because we want to, weather has nothing to do with it. Further, to-day we know approximately the speed of our enemy and we know with certainty our own. Therefore can we compute our distances with that factor best known which in the days of sails was least known. We take no thought of meteorology, it was the breath in the nostrils of Nelson. Hence we are not dependent for safety and sustenance on the number and proximity of our harbors, but on their position as it may affect our facility for conducting conveniently and expeditiously the lines of operation. In the Caribbean we have our base and Porto Rico; we have also the run through the Yucatan Channel to the Gulf ports; and we have the canal.

Shall we prepare strategic plans based on the supposition that the Panama Canal will be the objective and that therefore the theater of war will be near our shores?

For generations our people have believed that our integrity as a nation depended upon efficient coast defence. Such a doctrine is not on the whole unique or incompatible with our way of life and thought. We are not a maritime people and have little that pertains to the sea at heart. We are geographi-

cally isolated from the world at large and have worked out our salvation unaided by outsiders. We have had our wars; have risen to the occasions; and have relapsed into quietude and lived our lives self-contained, independent, complete. Little that was really vexatious or alarming has ever come to disturb our serenity or constrain us to believe that our mere dictum was not sufficient to make our screed sacred.

Before our war with Spain the *Oregon* and her sister ships were designated in the budget providing for their construction as coast-line battleships in the hope that their nomenclature would not lead people into fancying that our navy was to go into distant seas in search of quarry. Since those times, however, we have moved forward and to-day we build Dreadnoughts and super-Dreadnoughts and are proud of our success and boast of our prowess. But our strength is not increasing relatively to the increase making by foreign nations with whom we may have to fight. Hence it follows that since we are not endeavoring to maintain a parity of strength with these foreign nations, we must be committed to a policy that contemplates an objective near our shores.

Congressional action strengthens the above conclusions. Sir Wm. H. White,[1] late Director of Construction of the English Navy has lately written that his general impression is "That the recent ship-building programs [of the United States] have been largely influenced by political considerations of the moment, rather than by definite schemes of naval operations which would have to be performed in case of war, if American interests and over-sea possessions are to be protected adequately against possible and probable attacks." Political considerations are national considerations. Therefore if Congress limit the strength of the fleet to numbers of ships only sufficient to operate in adjacent waters it follows that our over-sea possessions are of secondary importance and that the Caribbean must be controlled by our force which must not go far from our mainland to wage war.

The defensive, we must bear in mind, is the weapon of the weak, and from its very nature precludes the formulation of strategic plans in which may be included, as a part of the scheme, the movement of the fleet for the purpose of conducting lines of operation remote from the home coast, for fear lest there be no

[1] *The Atlantic Monthly*, August, 1911.

fleet at hand with which to safeguard our own immediate littoral. But on the other hand there cannot be two fleets, one of them for the defensive and the other for the offensive. "There is but one of them whose objective is the enemy afloat and which puts in action all the resources of strategy to beat him without looking back to see what is happening on the coast." Strange things, however, do happen on the coast where old men dream dreams and young men see visions, and of them strategists must take account although such matters may be extraneous to the objectives of the war; for unless the people be content to let the fleet go away from the shore the government cannot send it. To distinguish between evil reports and good reports—quantities of both kinds will be in the air—and to convince the people of the truth is a most important duty placed upon strategists and is one which they must not fail to perform with care and circumspection, else will our fleet be limited in its operations to coast defence pure and simple, an inglorious foundation for a great and mighty nation to build on.

In bringing to a close these observations on strategy we find that from beginning to end there is required for its thorough comprehension a knowledge of many things besides the three things demanding especial consideration and their adjunctives which we have been writing about. We should know something of the characteristics of a people and what they may signify. For instance, in speaking of the ruggedness of the Englishman and the Frenchman, Admiral Fiske in his article on "Naval Power," has drawn a comparison between what one may expect of ships manned by the one and by the other. Also we should consider the import of the naval policies of governments; here the statement of the Kaiser, that the future of Germany lies on the sea, is pregnant. Again, the ability of the personnel afloat and the efficiency of his material are matters of much concern; the contrast between the navies of Japan and Russia is to the point; in this case, however, we recall that the world at large misapprehended the relative strength of the contestants. Again, we should review the naval history of a nation to learn from it what may be as it were, the inheritance of its seamen. Great Britain has one that in the simple reading of it must inspire its navy to attempt great things; and our own service, too, has an equally enviable record of which we are justly proud. And again, we should constantly observe what the different naval

powers of the day are doing to strengthen their strategic position: thus when we see that a nation is establishing a new base, bringing forward an extensive building program, and maintaining a strong fleet in certain waters, we come to think that she has in mind the intention to be ready to meet a condition of affairs different from that which previously existed. Therefore of all these many things we should be constantly taking note, and—stand by for a call.

"Naval strategy has for its end to found, support and increase as well in peace as in war, the sea power of a country," a quotation that epitomises the whole matter and fully covers the subject of naval endeavor until tactics comes into play. The aim of strategy is to obtain a position of superiority at a point in the theater of war; of tactics to obtain this superiority at a point on the field of battle. Strategy leads to the fight, tactics leads in the fight. As compared with the impersonality of strategy tactics is a personal affair—rapid, visible, active. But while tactics often changes its procedure it yet is based on sound unchangeable principles. What is tactics?

TACTICS.

Tactics is defined as the "science or art of disposing military or naval forces in order for battle, and performing military or naval maneuvers or evolutions."* The word, like the word mathematics is properly a plural noun but is now commonly regarded as singular. In my reading I have found "tactics are" and "tactics is" and both forms sometimes by the same author, euphony apparently determining the choice.

In the tactics of the sea and in that of the land—as in naval strategy and army strategy—there are many fundamentals common to both, like turning a flank enveloping a wing, concentrating fire, etc. But in naval tactics one must bear in mind that the surface of the sea is as unlike the terrain of the land as possible, and that, therefore, the obstacles and difficulties of the one are not at all simulated in the other. Often we say that scout ships are like outriders, cruisers like troops of horse, battleships like bodies of infantry. In some respects the likenesses are admitted, but in most respects and especially in the conduct of battle there is no similarity whatever. A ship fights underway, an army at

**The Century Dictionary.*

a standstill; the former delivers her fire from any and every position, the latter from only one, the front. A ship is a moving self-contained, armed and armored fortress of tremendous potentiality in a small constricted area; its mobility compared to an army's is marvelous. In the twinkling of an eye it can change front and formation and fight its battery all the while with unchanged efficiency. Hence the reasons why sea tactics in all details is different from land tactics: the former may be very broadly descibed as the movement in battle of inanimate bodies, the latter of animate ones.

Land tactics is much better understood and developed than sea tactics for the precedents are many and the changes wrought by time in the means are few. "Naval tactics"—I copy from a quotation of Mahan's—"are based upon conditions the chief causes of which, namely the arms, may change, which in turn causes necessarily a change in the construction of ships, in the manner of handling them and so finally in the disposition and handling of fleets." But although changes in armaments and consequently in ships, and changes in motive power and consequently in maneuvers, have necessitated changes in tactics, yet to-day as in the past the object of tactics is to enable one fleet to gain a position of advantage over another fleet so that its guns can be used with more deadly effect. Which is to say that when other things are equal, that commander who best comprehends the art of making good combinations preliminary to battle as well as during its progress will be the master tactician.

The art or science of naval tactics has been divided into four classifications—so writes Commander Yates Sterling in "The Nation's Defense."

(a) Distant touch (over 20 miles, when the smoke of the enemy's fleet will show its bearing, but not its formation).

(b) Visible touch (10 to 20 miles when the enemy's fleet will be in sight and some estimate can be made as to its numbers and formation).

(c) Battle approach (4 to 10 miles, when the enemy's fleet can be seen distinctly, and it can be seen accurately more or less, the course, formation and speed).

(d) Battle tactics (under 4 miles when fire will have commenced).

"During battle approach the fleets will maneuver for position advantage: during battle tactics for range advantage." This

indicates that each fleet will strive for the equivalent of the old weather gauge and then for that formation which will best unfold gun fire which will to-day be during (c) I apprehend, rather than at (d).

A fleet in search of its enemy will be so ordered that its units can in the shortest time pass into that formation which its commander believes will result in its obtaining the desired initial position which will probably be at the instant of visible touch, 10 to 20 miles, because at this distance "the relative position of the two opposing forces with reference to power of concentration, wind, weather and sun, will be determined," and soon afterwards, at from 6 to 8 miles, while approaching for battle, the firing will commence, and by the time the fleets are five miles apart it will be waxing fast and furious; then, if other things be equal, superiority in tactics will win the day.

How obtain this superiority in tactics?

Tactics to-day is still a purely theoretical subject which is disquieting the minds of naval officers everywhere, and which it is safe to say will continue to do so until the advocates of this or that system can put their methods to the test of actual desperate warfare. Our ships and foreign ships are not in themselves substantially different; but in the handling of these ships when they are assembled together so as to constitute fleets, our way is different from that followed by some of the great nations abroad. I gather from a reading of Lieutenant Pye's "A Few Hints to the Study of Naval Tactics," that the conclusion has been reached in our service that single line tactics will prove to be more effective in deciding the fate of a fleet in a modern engagement than either the double line or the group formation adopted by some foreign navies.

Single line tactics comprises three elemental formations—line, column, echelon; line for the approach, column for the attack, echelon for the pursuit. To change from one to the other is a tactical maneuver effected by three methods—the direct, the rectangular, the special. The direct leads from one formation to the other by the shortest route; the rectangular by turning at right angles, the longest route; the special by a combination of the other two. In the direct method the advantage of shortest route is offset by the disadvantage of change of speed; in the rectangular the advantage of unchanged speed is offset by the disadvantage of longest distance; in the special both the above

advantages and disadvantages appear. The foregoing explains single line tactics only in the abstract; for the concrete, readers are referred to many admirable articles in preceding numbers of the NAVAL INSTITUTE PROCEEDINGS, wherein will be found excellent mathematical expositions of numerous applications of the different evolutions to imaginary engagements between fleets on the sea.

Every system of tactics consists of successive movements, or simultaneous ones, or a combination of both, the object in all cases being to get at the enemy in the quickest way and shortest time and in the best position for using the guns both during the performance of the evolution and after the ships shall have arrived at the new position; for the crowning effort of all tactics is efficient gun fire. Therefore that system of tactics would seem to be the best that secured this preponderance of destructive power by the simplest methods and those most readily comprehended by the men who have to apply them; for the commanders of the different units of which the fleet is composed are responsible for the control of the movements of their ships as well as of the fire of their guns; their hands are very full, and the less they have to do with the complications of the signal book, the more can they devote their attention to the guns and the position of their vessels with respect to them. Commander Daveluy, writes in "A Study of Naval Strategy":

"Here is the idea of command we find in 'Tactics of Ships in Line of Battle,' by Lieutenant Niblack. A commander ought to have four things under his immediate orders: The speed, the course, gun fire, torpedo fire. Moreover, he ought to be in a position to know at each moment by means of the interior communications: 1. The helm angle. 2. The number of revolutions. 3. The distance of the enemy. 4. The distance and bearing of the guide vessel. 5. If each division is ready to fire. 6. If each torpedo tube is ready to fire. 7. The hull damages. 8. The number of degrees of list. The officer who has to meet all these requirements is nothing more than a registering apparatus."[1]

The criticism is unfair. To have things like speed, course, gun fire under his immediate orders is the reason why he is given the command of his ship. Further, to be in a position to understand things is different from the requirement that he himself should constantly have absolute knowledge of them. What he must know and what he does know is the significance of such

[1] Translation by Professor Alger, U. S. Navy.

information when it is given to him by his assistants who stand by to supply it when needed, as well as a good deal of other information not mentioned by Niblack. He must be prepared at all points to do the will of his commander-in-chief, and to this end he must know everything about his ship, not as a registering apparatus, but as a thoughtful, wise, intelligent seaman.

If the captain's life is not a happy one while he is endeavoring with all his might and main to handle properly his ship during the maneuvers of battle tactics—and we cannot maintain that it is otherwise—what must be the feelings of the commander-in-chief who has these instruments in his hands to make them play true and who by the skilful use of them in the developing of his battle tactics has the means of obtaining the victory if he comprehends how to make them conform to the necessities of the battle field? The difficulty in the situation, arises of course from the uncertainty as to what will be the tactics of the enemy. If he come to the fight in double column as did the Russians at Tsushima, the problem is too simple to need explanation. He is opposing the bow fire of a few guns to the broadside fire of many, and when the heads of his columns turn, he offers a fixed target for concentrated fire attack and consequent destruction. But if he be as clever as you and as determined to fight, he will be in battle array when met and the contest at the beginning will be for the weather gauge or the initial position with a view to that disposition of the fleet which will enable it to concentrate the fire of a number of its guns on some portion of the enemy. How many of these guns shall be assigned to this work of concentration, and what part of the hostile fleet shall be singled out to be overwhelmed by this volume of gun fire, will, indeed must, depend upon the tactical formation of the enemy and upon our own line of battle. If both fleets make use of line tactics, both will come up to the scratch, in all probability, in the same order in parallel lines or slightly converging lines, and at 12,000 yards to 14,000 yards or 16,000 yards the ball will open. Shall all the guns of our fleet at this dance of death be concentrated against one ship of our enemy, or against two ships or three, or shall each ship in our line endeavor to pick out an opposite partner with whom to engage?

The answer will depend on the enemy—his strength in numbers, in guns, in accuracy of fire, in mobility and in discipline. I think our line should concentrate against one unit of his line so

long as the range of firing exceed 12,000 yards to 14,000 yards or over, for the loss of one of his ships must sensibly diminish the tactical efficiency of his fleet. If his line and our line are nearly abreast at these great distances, I would concentrate my fire on two of his ships; if possible the two flagships nearest the head and center of his line, for if they were removed he would be seriously handicapped when he closed in and the battle tactics at distances of about 10,000 to 12,000 yards began. At these distances, about six miles, I would suggest the concentration of three ships against one ship. Then, when our maneuvers brought us to within about five miles, I would order ship to fight ship. This suggested plan of conducting the fire tactics of a fleet is founded on the supposition that the hostile fleets seek a decisive battle, and that the battle tactics of the two will be in essence the same, each contestant, however, watching with intentness the other, ready to take advantage of every chance that may be offered for gaining a position of superiority. If no such chance be offered and the opposed fleets be of the same strength and efficiency we arrive nowhere, for all things will be equal, an utterly absurd situation as was pointed out in the beginning of this article, because it eliminates the human factor, the most variable of all the factors in the world. Since, therefore, it will be a human impossibility for the two hostile fleets to act in common, employing the same maneuvers, at the same time, in the same way, the question for tactics to decide is what will the enemy do and what will we do? Who is to be the better man?

I venture to suggest that the science of mathematics cannot give us the answer; neither can the game board. Mathematics is an exact science: there can be but one line of reasoning, and but one answer to the problems. Tactics is not at all an exact science; its movements are not in sequence, its reasons are not logical and its results cannot be foretold or forfended. On the game board the same man attempts to play two parts: I, an American, inborn, inbred, ingrained, attempt to maneuver, say —the German fleet, to do so like a German; the thing is a psychological impossibility. I do not wish to aver that mathematics and the game board are of no account and ought, therefore, to be discarded in the study of naval tactics and strategy; for as a matter of fact I hold a contrary opinion. By the use and comprehension of both we should be enabled to discover elemental truths and errors and to agree upon the fundamentals of the

system of tactics we wish to adopt; and from these principles to evolve a signal book with which we can drill our fleets and attain to a high degree of proficiency which will stand us in good stead whatever system may be tried in opposition.

After an engagement between two fleets has lasted until one of the antagonists has gained such tactical superiority over the other that the latter has begun to disintegrate, the melée is sure to follow when each ship individually is expected to go into the fray and take care of herself without the restraint hitherto imposed by tactical considerations and the orders of the signal book. When the Spanish squadron emerged from Santiago, a single signal, "the enemy is coming out," was sufficient. In what ensued there was no tactics to speak of; it was a case of every man for himself and the devil for the hindmost, with both the pursuer and the pursued. Not dissimilar was the tactics of the Russians and the Japanese during the sortie from Port Arthur. But at Tsushima there were battle tactics by the Japanese from the start almost to the finish; and it can be said that Nelson always used tactics to enter into his great sea fights. But he also informed his captains that they would not be held responsible if the misreading of a signal caused them to lay their ships alongside of the enemy—which they promptly did during the melée. Superb tactics was that of Admiral Farragut entering Mobile Bay and splendid his taking the lead—a perfect example of the power of a man to seize his opportunity; but later when the *Tennessee* came at him with a rush, it was ship to ship that fought. And it cannot be otherwise; for as the battle progresses ships sink or fall out or are cut off; disorganization ensues, and there can no longer be, because of the attending state of affairs, any tactics or any further use for it.

Speed, mobility and discipline in a fleet are the essentials of tactics. Of speed volumes have been written and the number is not yet finished. It plays a part in the struggle for initial position. But even here this position need not be lost on account of inferiority in speed, for it is difficult to establish which of two fleets is the faster, and it is an error to suppose that a difference of speed exists because one of two opponents changes his bearing, or to conclude that the speed of both is the same because the bearing remains constant. And after all what does it matter if both fleets mean to fight! The faster fleet will be on the outer circle, the slower on the inner, and his guns can carry no further

than yours. Superior mobility rather than superior speed will help the winning tactics. The ability to change course, turn quick, offer broadside, bow or stern, stop, go ahead, all with greater celerity than an enemy, gives you a tactical superiority that places you at an advantage over your less dexterous opponent. With moderate speed relatively, decidedly better mobility and a fine discipline, we are well off tactically.

By discipline I mean skill in the practice of performing tactical maneuvers, a ready comprehension of and familiarity with the signal book and a thorough apprehension of the strength and mobility of the components of the fleet. Practice will make perfect. I suggest, therefore, that for this purpose and also for strategic instruction, our fleet be divided into halves, one-half to go to latitude x, longitude y and from that position to attack the Panama Canal which the other half will defend. Confine the sphere of operations to the limits set by the Chesapeake on the north and Trinidad on the south and restrict the time to about two weeks; and let the battle rage. Make few rules to govern the game, for in real war no rules hold between belligerents; and permit the use of every means a fleet might employ or resort to in time of actual warfare, such as the holding of bases and stations, communication with the strategic board at headquarters and the employment of aeroplanes, wireless telegraph and telephones, cables, despatch boats, torpedo craft, scouts, auxiliaries, etc. After the completion of the winter exercises on the southern drill ground, divide the fleet again, changing admirals and ships, and again simulate war on the northern rendezvous. In other words, make of every cruise between the northern and southern drill grounds, a battle. The determination of the results and the lessons to be learned, might be assigned to the War College and that institution might issue its conclusions in the form of an elementary guide book of tactics from the use of which might be evolved in time, a satisfactory system of tactics. So far as I know no such system is in present use. I beg to suggest in this connection, that captains, as many of them as can be spared from other duties, be detailed to the War College for instruction, for they are the men on whom will fall the responsibility of command when the war does come, therefore they of all others are the men who ought to cultivate their gardens.

Tactics in the last analysis means gun play; and it is solely for the purpose of participating in this play to the fullest extent pos-

sible with the means at our disposal that war ships are designed, built and manned. It is solely with this purpose in view that our ships are drilled, our fleets maneuvered and our system of tactics evolved; and it is solely from this point of view that strategy is developed and provision is made for the future. Or, we may say, strategy leads to tactics, tactics to gun fire, and gun fire, if superior, to victory. Hence it follows that in the fleet, and in the units of the fleet, in all things that belong to them, that touch them, everything must conduce to one end, gun fire. In the restricted meaning of the word gun fire, that is, in target practice or in the domain of making bulls'-eyes, our navy is second to none. Therefore if we can deploy our fleet so as to be on at least even terms with our enemy—if our tactics is as good as his; if we can reach the theatre of action at least as soon as he can—if our strategy is as good as his; then if he proposes to fight it out, "we have the guns, by jingo!" This leads us to the thought that, other things being equal, we have the remaining thing, an obtrusive statement whether true or not.

Until the invention of gun-powder the only weapon inherent in a ship was the ram. Then came the gun the only weapon of Nelson and Suffren. At the Crimea appeared the armored ship and then came the two weapons, the ram and the gun. Farragut relied on the gun and wooden walls though there were monitors and armored rams in his day and he fought both; yet he stated that the best defence lay in one's own rapid fire. At Lissa both rams and guns were used and because one ship was sunk by the ram of another, enthusiasts assigned as conspicuous a place to the ram, when working out problems in tactics, as to the gun. There is no question that ships accidentally in collision have sometimes been sunk by a ram; and sometimes not; the White Star steamer *Olympic* when struck full force by the English cruiser *Hawke*, closed her bulkhead doors and successfully limped back to port; but the *Hawke* lost her bow built for ramming, and so she, too, with doors closed and in addition with collision mats over her bow, limped back to port in safety, but in a useless condition for waging war. War ships are still built with ram bows for offence, but that the ram will ever be again used in warfare seems to me beyond the bounds of probabilities.

Next came the torpedo, it is a terribly destructive weapon and there are many officers of great ability who believe that its future will be as brilliant as the guns; therefore, we find it installed in

battleships, cruisers and other types of war ship. Nothing that I have read of the use of the torpedo in warfare, real or simulated, inclines me to think that capital ships can accomplish as much with it as with the gun. On board torpedo craft and submarines the torpedo is the special weapon placed there for a special purpose—for coast defence and dashing work near a base: even so, however, in peace practice it as often runs false as true though circumstances are in its favor.

The moral force exerted by the torpedo has at times been quite as potent as the destructive force, but that the dread of either force will hereafter exert any influence in shaping the tactics of fleets in action is problematical. We open fire at our enemy when 6 to 8 miles distant and we keep it up with greater frequency and accuracy the nearer we approach. It seems incredible that both of us could live to come within 6000 yards—three miles—when the torpedo might become effective. If, however, this distance be reached and our guns be not able for some reason to demolish our enemy, then let the torpedo craft—not ourselves—shoot the bolt; though here we must remember that a battleship mounts 20 or 30 rapid fire small guns on purpose to render such attempts abortive. "If I were king," I would remove torpedoes and ram bows from capital ships and give the weight and space to ammunition. The torpedo boats and vessels I would have and those that were sea keeping I would send out with the fleet; the others I would hold for shore defence; also the submarines. To encumber a battleship with a submarine, as someone has suggested, would be, I suggest, a bit of a mistake.

Fleets comprise three types of vessel—battleships, cruisers, torpedo craft, armed with guns and torpedoes. In the first two both gun and torpedo are the weapons of the offence; in the last one the torpedo only is for the offence, the gun is for the defence. The battleship type is the armored type and may be subdivided into battleships, battleship cruisers and armored cruisers. They constitute the offensive strength on the sea of the nation that owns them; and such of them as can be placed in the main line of battle are known as capital ships. Cruisers may be subdivided into scouts, despatch vessels, gun-boats etc.—an unarmored type, the fighting adjuncts of the armored fleet. They perform minor duties; protect bases; and those—of them that can be used for scouting and reconnoitering are indispensable; the more of them the better. We demonstrated our weakness in scouts by letting

the Spanish squadron enter Santiago undetected: the Japanese proved their value by locating the Russians long before the battle began.

Torpedo craft are divided into boats and destroyers. The latter, the sea keeping class, grows larger year by year and will soon become in fact a scout, and with its great speed and habitability may be used as the quick restless eyes of the fleet. With increase of displacement will also come a corresponding increase in radius, gun power and all round efficiency. In the course of time, therefore, we may be led to the belief that perhaps our sea going and keeping navy ought to consist of only two types of ship, the all big gun battleship and the large sea going torpedo vessel. If this should come to pass and the proper proportion of the two types be observed—one battleship to four destroyers—the question of tactics would be somewhat less annoying.

How many ships of each type shall we require to meet adequately the possible exigencies of a war waged against a foreign foe? In other words, what shall be the strength afloat of our navy? The answer must depend on what may be our international policy. Admiral Mahan states the matter as follows: "The question for the United States, as regards the size of its navy, is not so much what it desires to accomplish as what it is willing or not willing to concede."[8] We have the fixed intention of holding the Panama Canal for ourselves alone, and of vigorously supporting our own construction of the meaning contained in the Monroe Doctrine. In these two particulars it is safe to say that we are not willing to concede anything. Therefore must we have knowledge of the forces of those foreign powers whose activity on the sea may lead us to suspect that perhaps at some future day they may challenge our ability to maintain secure that which we now possess. With this knowledge of the strength afloat of a possible enemy, we must, if we would sustain our policies, keep abreast of, or to make sure, a little ahead of, the naval movements of these foreign powers.

Now this keeping on at least a parity with other nations, may not appear at first sight as a hard thing to do; nor is it if we consider only the personnel, the fighting spirit and the aggressive character of the ship itself. But when we include in our consideration of the navy all its parts, viewing them as a great and

[8] *The North American Review*, September, 1911.

mighty national institution, we encounter difficulties because of the manner in which our naval establishment is provided for, a manner different in principle from that customary in some foreign countries. For instance, the German government puts in motion a carefully worked out plan of naval expansion which we know will be consistently adhered to. Its execution as well as its inception belongs to the executive branch of the government, the legislative branch votes only the funds. In our country the legislature not only votes the funds, but it controls the entire naval establishment, administrative, executive, financial; navy yards, bases, fleets, ships, officers, men—all are under the will of Congress, and this subjection is not good for its consistent expansion and steady improvement, for its efficiency and its morale.

When we see that a foreign navy is augmenting an already powerful fleet we conclude that the increase will place that nation in a position to compel us to concede some things which we ought not to be willing to concede. We therefore lay the facts before Congress and request that our hands be relatively strengthened. This is all we navy men can do. Our fate rests with Congress. Hence the true answer to our question "How many ships shall we need? becomes academical, for it will depend not on what the navy department may submit as the proper number but on the opinion of the majority of the members of both houses of Congress. Sir Wm. H. White has written* that in the next three years Germany will have overtaken the United States in the number of capital ships when the vessels now building or decided upon in both countries are completed. Germany will then possess 17 of the Dreadnought type and our navy 10. Then as between our country and Germany, other things being equal, Germany will possess the remaining thing—seven more capital ships than the United States.

From the above point of view it is plain that our condition is not altogether reassuring if we hold to the idea that it is worth our while to maintain a status of superiority as regards the security of the canal. It may be argued that an attack on the canal must be made in near proximity to our shores and that therefore the need of having as a whole a number of ships equal to the whole number in the German Navy is not evident, for any foreign power would because of the distance from the appre-

**Atlantic Monthly*, August, 1911.

hended theater of war, have to retain for the safe guarding of its own littoral a larger force than we would have to hold at our home, our distances being so much the shorter. I should say that while to a limited extent this might be so, yet it cannot be proved that it must be so. On the other hand, I think it must be admitted that if we are in numbers the equal of an enemy we are by so much in a better position to contend with him on at least even terms.

The men of the navy can shape naval policies; draw up plans; arrange programs, and construct fleets: and we ought to be able and be sufficiently interested in our profession, to attend to these scientific and expert affairs better and more whole heartedly than civilians however intelligent and painstaking they may be. But be this as it may, we can unquestionably and by unanimous consent, fight our ships better; and this function permitted to us, we undertake with alacrity and we assume the responsibility with gladness. When our countrymen see a hundred of our ships at the mobilization of our fleet in New York Harbor and gaze with pride at the 24 battleships there, they shout hurrah, and go home with the idea that we can whip all creation. We can't, as a matter of course, for, if other things be equal, as pointed out above, our 24 capital ships can be over-matched by the 30 equally efficient capital ships of some foreign powers; so perhaps they might do the whipping. However, the value of these capital ships depends on the number of guns they carry; the guns depend for their value on the number of hits they can make; the hits on the men behind the guns; the men on the officers and captains, and these in turn on the commander of the fleet. If our admirals be the smartest and ablest of all other commanders, so will our officers and men be cleverer and more skilful than others, and our gun fire will be more accurate, our ships more efficient, our tactics more scientific, our strategy more convincing.

To secure this condition of certitude in respect to our navy, we must cultivate that habit of mind which will have as its sole object, irrespective of the right or the wrong of a quarrel, or the chances of winning or losing, the prestige that inheres in the concept of the offensive. "Everywhere" writes Captain Darrieus, French Navy, about the English fleet, "Everywhere is combative ardor from the commander in chief to the last sailor. Each one knows where he is going and what he has to do, so that all efforts tend to a single object and work with an irresistible

force. This is the offensive spirit in the full acceptation of the term and the idea." It is forcibly expressed in the doggerel,

> "Thrice is he armed that hath his quarrel just;
> But four times he that gets his fist in fust."

To be "fust" on the field and to take the aggressive, to be fast and furious, have, even when other things have not been equal, often won the day. Nelson with forces inferior in number to his opponent won his two greatest naval victories by assuming unhesitatingly a vigorous offensive: and Admiral Farragut by his strenuous application of the principle saved his fleet at Mobile, and won many other victories. Hence we see that with even an inferior force, the man with the more indomitable will can overcome many inequalities and difficulties. This ascendant power of will Admiral Fiske aptly calls "spirit," and this it is that has inspired the officers and men of the fleets and armies of great captains to fight bravely—Napoleon's presence on a field of battle, despite the proverb that Providence is on the side of the big battalions, was said to be equal to a reinforcement of 30,000 men; and Mahan adds—"Providence is most often on the side of men who best know how to manage their battalions, or their ships; the smaller have more often triumphed by their conduct, than the bigger by their weight."[19] I think that the significance of this "spirit" as the dominant factor not only in making a navy great and powerful, but also a government, is well exemplified in the supremacy of the world attained by the Roman arms. When the Romans went forth to war the gates of the city were left open in accord with the haughty courage of the Republic which commanded victory by not admitting the possibility of defeat. Of what avail the subtlest strategy, the cleverest tactics, the finest ships if a haughty courage be wanting! How can we, as a nation or as a navy, accomplish aught of value if we stand in pause instead of not admitting the possibility of defeat! If all other things in the world are in our favor but the one thing of enthusiasm for and belief in the offensive and the abilities of our superiors to win and in ourselves to help, in the spirit which made one Confederate fancy himself the equal of three Yankees, we cannot win. If we go to the fight expecting to be beaten we'll not be disappointed.

[19] Reflections . . . . suggested by the "Battle of the Sea of Japan," by Capt. A. T. Mahan, NAVAL INSTITUTE PROCEEDINGS, No. 118, June, 1906.

THE PERSONNEL.

Who are these men, our superiors, who are to instil this spirit of *dulce et de corum est pro patria mori* in us and animate our actions, and how do they attain to the distinction of greatness? By greatness is here meant the universally acknowledged attainment of leadership by the performance of acts and deeds that are extraordinary in the benefits or advantages resulting therefrom to the nation to which the performer owes his allegiance. This position of recognized ascendency of one man above his fellows is reached and held by him because of his superior prescience, forcefulness, abilities and education: he perceives intuitively the right thing to be done and he knows from his education and practice the best way to do it. Some men "are born great, some achieve greatness and some have greatness thrust upon them." We may say, for example, that some sovereigns like Queen Elizabeth and the present German Emperor were born great; some men like Nelson, Napoleon, Grant, Lincoln, achieved greatness, and some men like Farragut, Porter, Dewey, Sampson, had greatness thrust upon them. In our navy only the last kind of greatness is likely to be thrust upon us for ours is a service in which every officer will eventually reach the rank of command when he may expect to receive orders to assume the leadership of a fleet and engage the enemy; and be given the opportunity whether wished for or not of winning the laurel.

We are cast upon the tide that may lead to fortune—fortune in the sense of fame—at Annapolis. "Is the present system at the Naval Academy," asks Lieutenant Cresap, "the best one for achieving the purpose for which the government maintains it"?" Evidently to many it is not the best system. Too much theory says one; too little, says another. More of the practical, less of the practical; general principles only, specialization alone; a five year course; a six year course; etc.—all have strong advocates. There is, I venture to suggest, a deal of stuff taught at Annapolis in the endeavor to make a square peg fit into a round hole, but none the less we are all pegs, and when not in our holes all alike so far as our usefulness for one general purpose is concerned. I read, "Many persons believe that the efficiency of our navy would be increased 100 per cent if every officer"—note that —"and every man were a trained seaman." Lieutenant Taylor

[11] June PROCEEDINGS, 1911.

Evans leaves no doubt as to his meaning, for he further says; "It is often advanced that a knowledge of seamanship is useless to an officer; if so it would be better to close Annapolis and borrow from the second lieutenants of the army." Ye gods and little fishes! Are we to learn to back and wear, back and fill and to chapel ship? Whatever that may be, I don't recall it in Knight, What for? Because Farragut in a steamer, Worden in a monitor, Togo with an armored fleet, learned their business in sailing ships; and further, because an officer of one of the stately ships of the merchant service must receive his training in a sailing ship? The reasoning is not conclusive.

To know how to hand reef and steer—words of archaic signification—did apparently quicken the faculties and stimulate the activities so that, in some unexplainable way, an officer acquired the art or science or power, whatever we may choose to call it, of managing, controlling and working his ship and crew with ease, assurance and confidence. Was this so because the brotherhood of sailors was closer than is that of seamen? Was it because "To lay aloft in a howling breeze," inculcated in young men that mighty spirit of which we have written, and which remained steadfast with them from youth to old age, and carried them all, midshipmen, lieutenants, captains, admirals and the crews triumphantly through the jaws of death? There are men of the old navy who will answer you, yes. There are men of the new navy who will tell you, no, notwithstanding the assertion of Lieutenant Taylor Evans, that "The history of the future will bear out the assertion that, other things being equal, superior seamanship will decide sea-battles."[12]

In the old navy, life on board frigates and sloops was as simple and open, as above board as were the ships themselves: officers and men rubbed elbows; and from captain to powder boy every man knew every other man; and seamanship narrow and broad, concrete and abstract interested all hands. In the new navy, life on board a battleship is, forward and aft, complex and diverse with its departments and compartments and organizations. We too, however, are proud of our ship, our target record, our football eleven; but it is as they approach the perfection of a machine that we admire them, the individual whether officer or man, is merely a cog. I asked an ex-apprentice, the other day, who had

[12] U. S. NAVAL INSTITUTE PROCEEDINGS, No. 138, June, 1911.

served his time and left five or six years ago, who was the captain of his ship? He answered, Fitzgerald. Fitzgerald I happened to know was a boatswain's mate. I mentioned the names of his captain and executive officer but he had no recollection of ever having heard or seen either or any other officer. I wonder whether these officers even the midshipmen, knew Fitzgerald. Perhaps they may have seen him running a hawser while the midshipmen were below working at "Strength of Materials," instead of learning not only how to run a line in a seaway but also how to command the boat's crew and Fitzgerald too. Here again I by no means wish to aver or imply that mathematics is not necessary to the making of an efficient officer. On the contrary, I assert now as heretofore that it is a *sine qua non*. But as a distinguished American divine said when he dismissed his congregation upon the approach of the British troops, "There's a time to fight and a time to pray and now is the time to fight." It is our failure to discriminate the time that in my opinion has something to do with our lack of seamanship.

Annapolis ought to fit a man to be a midshipman and not at all an admiral or a captain or even a lieutenant notwithstanding that in time he will be a lieutenant and a captain and an admiral. That these greatnesses will be thrust upon him is as sure as fate; but the way from the subordinate first rank to the high and mighty last one is hard and toilsome and each man must play many parts, his acts being seven ages. At first the whining school boy at Annapolis, corresponding in some respects with the infant mewling and puking in his mother's arms, of Shakespeare's ages. And then the graduate learning that he is a man and can grow a beard and will have to handle men. Then the lieutenant "full of strange oaths," for now he has young officers as well as seamen under him to do his bidding, and he has charge at times of the peopled deck. Then the lieutenant-commander with more men and officers to command: sometimes he has to navigate his ship; sometimes be her executive; and he may even be given the command of a small vessel: he must be a man of some parts. And then the commander; the first lieutenant, or the executive officer of a big capital ship or the captain of a smaller ship Many cares, responsibilities and duties are his: he must be a man of fine sense and of force, for it may be that above him there stands but one man while below him are many men who rely upon his judgment and depend upon his acquirements. The sixth age shifts into

the captain; a man of might; an overlord, who has the lives and happiness of many officers and men in his keeping, and the efficiency and safety of the great ship under his eye and hand; a position of great dignity and trust and importance, requiring wisdom and experience and knowledge. Last scene of all the admiral; a title borrowed from old Arabic where it signified then, as it does now, the ruler of the sea. He is commander-in-chief of the fleet; and all that therein is is under his control. His apprehension must be extraordinary; his perspicacity acute; his professional attainments of the highest. He is the exemplar entrusted with his country's honor.

Our life is a full one, and an anxious and a trying one, for we, ourselves, are well aware how easy it would be to fall into the quiet unconcerned ways of peace and to pay slight heed to the needfulness of being prepared for war. But for us naval men there ought to be no peace whether our country be actually at war or not; and our minds ought to be occupied with the fighting of battles in imagination if not in reality. Though peace hath few victories for military men and none at all for American naval officers, yet none the less while it lasts, be the time long or short, we must keep on edge obsessed by the idea that war will be on the morrow when we shall be weighed in the balance.

In connection with the requirement that we be always trained to the minute, we men of the navy of the United States may be thought to be at a disadvantage in a comparison of our lot with that of officers of the army and of some foreign services where what is reckoned as greatness may be achieved by extraordinary exertions off the field of battle as well as on it: the bubble reputation is there for them to seek even though it be not at the cannon's mouth. This prize cannot be competed for in the same way among ourselves in the navy. With us, a captain, for instance, cannot displace or go ahead of an admiral no matter how much better qualified he may be than his superior to hold a command; he must bide his time and wait his turn. We may think that perhaps such an arrangement is not calculated to stimulate ambition or bring out the best efforts; and certainly it has been exclaimed against by some of the able men in our service; and promotion by selection has been strongly urged. On the other hand, it can be averred that promotion by seniority does, on the whole, make for content; a praiseworthy state of mind which obtains to-day to a greater degree than ever before, because under

the present system of retirement, the incompetents, from whatever cause, are plucked, and we who escape, apprehensive lest our turn come next, rest no longer satisfied with the mediocrity of other times, but instead, strive to do with all our might whatever our hand findeth to do. The success that has attended our endeavors can be measured in many directions by the ships that now compose our fleets, by the efficient manner in which they are managed and by the enthusiasm of the officers and men in the performance of their manifold duties. Can these fleets accomplish to-morrow the purpose for which they are held in readiness to-day? That purpose is the command of the sea; and whether our fleets shall achieve it or some other fleets will depend on the strategy, the tactics, the guns and the personnel; and most of all, perhaps, as we have said before, on the commander-in-chief.

From the foregoing it follows that the command of the sea may be expressed in the term of an individual. Nelson was the embodiment of the sea power of Great Britain, writes Mahan. Yet Nelson sometimes made mistakes in strategy, as, for instance, when he sailed in the wrong direction to intercept the French fleet; and in tactics, too, incomparably brilliant and successful as they were, as, for instance, when he bore down at Trafalgar in two columns upon the French line at right angles to it, and offered thereby two points for concentrated attack. This tactics was not unlike the Russian approach at Tsushima. Maybe the Russian admiral had read of Nelson; if so he had not read deep enough. Then why is it that Nelson has achieved the unique distinction of being the greatest sailor that ever sailed the sea? I doubt very much if he equalled his enemy as a strategist, for Napoleon controlled the movements of the French fleet; and as a tactician he was not, on the whole, the superior of his enemy. True, his courage was consummate, his faith unbounded his determination irresistible; but many another man has these qualifications of leadership; and undoubtedly his enemy was personally as brave as he. But Nelson's fleet, as well as Nelson, loved to fight; his enemy's did not. Therein lay the difference, all the difference, between them that made all things unequal. This lust for the fray had been inculcated by Nelson himself—his personality, his enthusiasm, his influence. "This Nelson," wrote one of his captains, Duff, "Is so loveable and excellent a man, so kindly a leader that we all wish to exceed his desires and anticipate his orders." Is there any wonder that the English fleet of those days was Nelson's fleet,

soul and body, and that in him was incarnated the command of the sea?

Another name comes to mind as an inspiration and model in recalling the deeds of those great captains to whom sea power and command of the sea were synonymous—that of Farragut. Farragut's opportunities were different from Nelson's and his task dissimilar, for he fought not against fleets but against forts, not against foreigners but against friends; but his operations were for these reasons none the less hazardous and none the less remarkable; and the qualities of his leadership none the less skilful and none the less eminent. "I will attack," he said, "regardless of consequences, and never turn back." And as a consequence we have in the annals of our navy, New Orleans, Vicksburg, Port Hudson, Mobile Bay. We may say of such men as Farragut, Nelson and of others like them, that they never know when they are beaten. Are they ever beaten? It was the contemplation of Farragut's character that led Admiral Belknap to write, "Ah! that is the sort of men we want Annapolis . . . to turn out. A man who knows his own mind, has the courage of his convictions, believes in himself, and in the loyalty, devotion and intrepidity of the officers and men he commands under any circumstances of peace or war. An officer whom to know is to love, whose subordinates, in their great trust and supreme devotion, will follow to the death."[13] I beg to call attention here, as elemental in the shaping of the character of these two great seamen, Nelson and Farragut, and as a governing influence in their lives, to the strong, firm, enduring belief of each man in God. In all the letters of the most private and sacred nature written to those whom they loved best in this world, and also in their occasional private and public utterances, there is evident that simple, childlike reliance on the strength to do duty to be got from on High. There was no rant or cant or affectation about this belief in the power of the Almighty; it was genuinely there an integral part of each man's being. The question comes; will, if all other things be equal, the victory fall to the man who lifts up his heart to God?

We perceive from what history records of those heroes who have won victories on the sea, that not only did they have a knowledge of many things like strategy, tactics, gunnery, human

[13] Admiral Goodrich in "Esprit de Corps," U. S. NAVAL INSTITUTE PROCEEDINGS, March, 1898.

nature—their own and their adversaries—but they likewise possessed intellectual qualities of a high order. First, insight—the skill in discerning at once the central fact in any situation or combination—the germ of victory. And next foresight—the power of seeing how principles are to work themselves out or can be made to work themselves out. This signification of insight and foresight was given in explanation of the successful conduct of the strategy and tactics of the diplomacy of Germany, conceived and executed by Bismarck. I have appropriated it because it is of the essence of naval success quite as much as of diplomatic success. Insight means discernment, penetration, quick perception: you fathom your opponent's mind, you divine his intentions, you anticipate his movements. Foresight means precaution, prudence, regard for the future: you know who your opponent will be, you secure your interests, you prepare your plans, you make ready to meet him.

How is a man to learn so much? How can he be prepared at so many points? For we expect him not only to know the strategy, tactics, ships and men of his own navy, but also to have an insight into the movements of his enemy, and a foresight of the principles of his naval policy and how he will apply them. I suggest that he can learn much about ships, tactics, strategy and men, by going to sea constantly during the earlier years of his career, until he reaches the rank of commander, and studying the histories of American and foreign navies. As a commander I would have him take his trick at the War College, and not promote him captain until he had done it. As a captain I would have him take a second trick at the War College, and not promote him admiral until he had done it. No, gentle reader, I am not a War College graduate; I have only seen the institution from the deck of a ship. "The final result of a properly conducted war college course is that those who have profited by it are better fitted to solve the questions arising in the conduct of departmental preparation for war (general staff work), than they would have been had they not had the advantage of formal and regular instruction in the art of war, and the course of study has at the same time developed their capacity for assuming in their own persons the responsibility of leadership which cannot otherwise be learned in time of peace."[14]

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[14] "The Field of Work to Be Filled by a Naval War College," by Capt. Wm. L. Rodgers, June, 1911, PROCEEDINGS.

In dwelling on the graver and larger matters that fall under the cognition of the naval officer to whom such knowledge is of vital importance if he aspire to secure for his country the command of the sea, only a few words here and there have been spoken of the materialistic side of the navy, the side he learns most about during his younger life on board where he lives, moves and has his being among the tools with which he must then and thereafter do his work; a work the successful accomplishment of which depends in a measure on his ability to master the principles and the capabilities of perhaps the most notable production of the scientific and the practical men of the day. The ingenuity and skill displayed in making a battleship the most powerful engine of destruction in the world are altogether wonderful; and the inventiveness exhibited in designing the means wherewith to obtain this power is altogether marvelous. We find in the designing, building and equipping of our ships every principle of science and every device of man brought into practical use for the express purpose of developing the most perfect means which will enable a man to destroy his fellow man. Altruistic by nature and living as navy men are, yet of all men are they by training and habitat the most ferocious. The paradox is explainable in a measure perhaps by the fact that of all men, navy men have the least to do with the bringing on of a war. They are not taken into the counsels of those who decide that a crisis has arisen between our country and another country which necessitates an appeal to arms; and they are not instrumental in shaping public opinion and demanding redress for insults. None the less, however, are they the ones who must settle the quarrel by the skill with which they use their ships to destroy other ships and kill the people on them. In order that we men of the navy shall perform this duty of killing our fellow men in as thorough a manner as possible, we devote our time and thought, our energies and our intellect from the day we enter Annapolis until death absolves us from further participation in this glorious existence. An existence of which honor is the mainspring and "our country, right or wrong" the controlling principle. Base hirelings we have been called—hirelings if you choose, but not base; there is nothing base about the American naval officer; and the pay he receives precludes the thought that he serves for lucre. He serves because next to God, he loves his country.

"What joys, what glories, round him wait,
Who bravely for his country dies."

The ship in which a naval officer serves his country and hopes to win joys and glories is the outward visible sign of the physical force of a navy, and is typical of the sea power of a nation. More particularly as we have said before is the capital ship illustrative of a state's sea strength because to her rather than to any other class of vessel is assigned the role of fighting for the command of the sea; for this purpose is she built and commissioned, and for none other. Look at her! She is to-day an immense floating machine of astonishing complexity and can be made to function properly only by men skilled in the use and understanding of mechanical contrivances and inventions. We press buttons, heave over levers, open valves, and wonderful results follow. It has been jocosely remarked that an old time officer when assuming command to-day finds himself as bewildered as Alice in Wonderland; a state of perplexity not surprising, for the rapid march of events cannot be kept step with by an officer doing duty along other lines.

Some thirty years ago the building of our new navy was begun. Then was written; "Never has there been a period in time of peace, when such large expenditures were being made for naval purposes as at the present, and never a period in the history of steam screw navigation when such radical changes were being effected in the construction of ships of war, in the mechanism of steam propulsion, and in the application of machinery to various purposes on board ships hitherto accomplished by hand. Never before have such vast strides been made in so short a time in the fabrication of great guns for naval warfare, necessitating, of course, the introduction of new mechanical appliances for working them."[13]

There is no word to alter in applying the above description of naval development thirty years ago to the situation of the present moment. It may have been an exceptional epoch then, if so, it is so no longer, for among all the nations of the globe there has never before been exhibited such naval activity as at present. And furthermore this activity will be found to be quite as energetic next year and the next and so on to the end of the chapter. For so long as we hold to the militant policy that the Panama Canal shall be distinctly ours we must build the best ships in the world. Similarly to support their policies other nations must have what

[13] "The Warships and Navies of the World," by Chief Engineer J. W. King, 1881.

they consider to be the best ships in the world. Hence however much we may wish for a reduction of armament, we may rest assured it will never come and that the race for supremacy in battleships, and other ships also, will never cease. For, if all other things be equal, the most modern ship especially the battleship will be the best ship.

But it may be asked, how are we to know that in the development of the capital ships here and abroad our ship is the best and will be the best? We don't know; and we shall not know until the time comes when we oppose our ships to those of an enemy. While, however, we spare no efforts and expense to produce a ship that in herself shall be the superior of every other ship of her kind, yet all the time are we fully conscious that if we put the best of tools into the hands of inefficient workmen, we shall not obtain as satisfactory results as we would were the tools less efficient and the men more so. This brings us back to the man, to a consideration of his fitness rather than to the warlike qualities of his ship; for it is the navy officer who must fight the ship. Only when two opposing men are equal in every respect will the question which is the better ship, his or ours, be positively answered. But no two men can by any possibility ever be the same under the same or under different conditions, even though their ships as mere ships may be—as was pointed out in our beginning. Therefore do we return to where we originally started that, other things being equal, the remaining thing is the man.

* * * * * * * * * *

We commission a battleship, a war vessel common the world over, designed with the idea that our disposition of her guns and armor is better suited to the work in hand, fighting, than another man's, our enemy, whose ideas embodied in the ship he commands, are the same as ours. We combine a number of our ships into fleets, so does our enemy. We believe our fleet is better than his; he thinks his is better than ours. Both fleets are dedicated to the same end, fighting; and to do this most effectually each fleet maneuvers according to a system of tactics which each believes will give him the advantage in the death struggle about to follow. This struggle will take place at some place on the sea where the commanders-in-chief have reason to believe the theatre of war will be, having in mind the situation of their respective bases,

bases of operation, the lines of operation and the objective. Towards assembling his force for fighting, towards effecting this concentration, each commander resorts to that strategy which he believes will enable him to circumvent his opponent, and assure to him the command of the sea.

In the above brief abridgement, as well as in all that has been written before about strategy and tactics and fleets and ships, we have only attempted to repeat what has been said and known from time immemorial, namely, that a navy depends for its success, its prestige, its glory, on its officers. If our officers be the superior of other officers in knowledge, in attainments and in intellect, our navy stands to win: if not, to lose. "Finally," writes Mahan in "Sea Power," "it must be remembered that among all changes, the nature of man remains much the same; the personal equation, though uncertain in quantity and quality in the particular instance, is sure always to be found."

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

"PUNISHMENT" AS APPLIED TO SOLDIERS AND SAILORS.

By Lieutenant-Colonel G. Haines,
British Imperial Service and Commandant Detention Barracks, Aldershot, England.

"Punishment" as applied to soldiers and sailors.

Such is to form the subject of the following article.

I feel that in being asked to write it a great compliment is paid to me, and I intend to try my best at the risk of disappointing my readers.

I have spent thirty-three years among soldiers, sixteen of which have been passed respectively as governor of various military prisons, and commandant of various detention barracks.

Does this entitle me to write about sailors?

Yes, I think so, and civilians too.

They all belong to the human race, and differ one from another but little as a whole.

I will, however, write of the soldier here, in the hope that my remarks may be considered applicable to all.

As my active service draws to a close I can honestly say, and with pride, that I have always looked upon the "human being" among whom my lines so far have been cast, as my friends, both when free and when undergoing so called "Punishment."

Note.—Lieutenant-Colonel G. Haines is the father of the Detention System in England. He has been connected with prison administration for about 14 years in England and India, and has had the widest experience in the handling of both criminals and the ordinary offenders against discipline in the British army and navy. He represents what might be called the advanced school of handling offenders against society, and his views coincide entirely with the progressive movement now going on in most of the large prisons in this country, both state and national, toward a more rational treatment of offenders against society.

I will divide them into two:

1. The large majority.

2. The small minority.

The large majority includes the soldier who is free and remains so throughout his service-engagement, doing his daily work, and earning his pay, board and lodgings.

He is a faithful servant.

His life is one of honest work, pride of country and its traditions, healthy exercise, good companionship and general satisfaction.

All is well with him.

The soldier of the present day is an educated man.

If he, as an educated man, behaves like a beast and remains incorrigible, he must be got rid of as a noxious weed.

His disease is infectious and apt to spread, so out he goes.

It is obvious that the soldier, to be worth the pay he draws, and the food he eats, must be kept for ever fit and eternally up to the mark.

Enter . . . "The officer," another educated man.

Professionally, his education for many years past has been on the upward grade, and has rendered him fitted to handle and teach intelligent men.

He is, undoubtedly, the individual on whom depends the efficiency of the men, and right well does he obey the call.

This is beyond all doubt.

Were it not so, the state of things I shall presently attempt to describe could not obtain.

I now make use, for the first time, of the word "crime."

It is an ugly word and means disaster.

If crime becomes in any way "chronic" . . . Cherchez L'Officier.

Prevention, by everlasting vigilance, care, and instruction, which command respect and obedience, is far better than the sudden brutal so called *cure* which so often degrades the patient and points to the inefficiency of the "practitioner."

The main factors which keep an army together are:

Patriotism.

Esprit de Corps.

Honour.

Competition.

Power and courage to endure, and to play the game.

The whole rolled into one concrete word "Discipline."

When it is said "all men are equal," "one man is as good as another," when social democracy is the order of the day; the bottom drops out of the word discipline, and inefficiency and chaos reign supreme.

If a man cannot stand a subordinate position, let him strive hard to rise.

The higher he gets, the fewer masters and more servants are above and below him respectively.

Scripture tells us that all are not equal even in Heaven, and I am inclined to think that the master and man business may be somewhat overdone in Hell.

On this planet a happy medium and a proper distribution of authority must be arrived at to make existence possible, and fitness certain.

From a company to an army corps, efficiency (i. e. absence of crime), depends on the officer.

There are few men happier than the well conducted soldier.

There are few men more miserable or demoralized than he who leaves the track and drifts into . . . .

The small minority, which is made up of men who, through stupidity, carelessness and weakness, commit offences against the book of rules, and must pay forfeit accordingly.

They must be punished.

There are two kinds of punishment.

1. Expiation.

2. Reformation.

The first was the only kind for many years.

The second came up at the call of humanity, common sense and progress.

The first is merely a vindictive and very undignified wish to "get even" with a man, which degrades the punisher and the punished.

It obviously must be useless, if not dangerous, as applied to men whose business is to safeguard their native shores.

It blots a man out, rubs him off the slate.

Men differ in temperament, character and instinct, just as they differ in age, size and appearance.

In a detention barrack they are like sick men in hospital.

You do not give a gargle to a man with a broken leg.

It is obviously futile to treat all alike.

Each man's offence or desease must be diagnosed.

It must be taken in both hands and squeezed out of him.

The object of detention as carried out in the British Army to-day is, by rigorous discipline, systematic professional and industrial training to return the erring soldier to his unit efficient in all his duties, with a serious view of the army as a patriotic wage-earning profession: and to place in his hands the knowledge of a useful trade, and so enable him, if he so desires, to give the "unemployed" list a wide berth on discharge.

Re-enter . . . The officer.

The handling of the soldier under sentence in a detention barrack is a peculiarly ticklish business.

The necessary individual treatment is truly a laborious affair.

But it is quite extraordinary how the good results outweigh the disappointments.

The "ding dong" common sense of the treatment, with the unfailing justice, sympathy and help, appeal to every kind of malefactor.

The biggest blackguard curls up under it, and the man who, speaking generally, remains totally unaffected by it, is either one who will some day, if he does not already, merit hanging: or the totally depraved, half baked, degenerate imbecile, who should be in an asylum, and not entrusted with the "safeguarding of his native shores."

In the early stages of the change from imprisonment to detention in England, grave doubts were entertained as to its ultimate success.

"A Premium on Crime" and such like names were suggested.

More recently eminent naval men said . . . "It may be all right for soldiers, but it is doubtful whether it be not too easy going for sailors," or words to that effect, but I fancy these officers have changed their minds, as the navy have taken the detention barrack methods into use.

As for the sailors, I have had charge of able seamen, stokers, cooks mates, naval ratings of all kinds, and have found them splendid men, with a big M, amenable, obedient and hardworking, in an atmosphere of justice, sympathy and assistance.

How is it done?

Again I say "Cherchez L'Officier."

In this case he stands alone.

The success of his establishment depends solely on him.

There is no chain of responsibility for him to handle.

The responsibility rests upon his shoulders only.

He must, therefore, be the right man or his life must be unbearable.

Once he has trained his staff to look through his eyes, the the thing goes of itself.

Till then he can never rest.

His best friend is the busy day.

Everything done in quick time when not at the double.

The man under sentence must be kept fully occupied in mind and body.

Make him understand that his day is spent entirely for his own physical and mental improvement.

Keep him in the open air.

Give him enough to eat.

Make his instruction interesting, and at the end of a short lecture, make him answer questions.

Do this, I say, and you will find that he, perhaps unconsciously, drinks deep of the chances given him.

Forgive me if I repeat that these men are all very much alike as a whole.

It is absurd, it is more, it is wicked to judge a man untried, and stamp him as physically and morally unfit just because his head is a certain shape, his ears stick out at right angles to his head, and he has forgotten to clean his boots.

People there are, who will tell you that he is a "type," that, either from heredity, or environment, or both, he must be an unreclaimable swine.

If this man does not rear up and break rules and furniture such people are badly disappointed: not necessarily because the man is better than they thought, but because their pet bubble has been pricked.

Low environment, I grant, is a fierce enemy to tackle, but I fancy the descendents of men who sailed for Botany Bay at the government's expense, have bust the heredity theory also.

There is a spark of good somewhere in every living man.

It only needs blowing steadily till the glow becomes a flame.

The flame soon purifies the evil mind found in a rotten body.

Penal treatment is degrading and stamps out the spark, so "blow," say I, "blow all the time."

I ask leave to state that in the British Army since the present detention methods have come into use, "chronic" crime has totally disappeared.

It is no longer intermittent.

At worst it is sporadic.

The detention barracks are nearly empty.

The ranks are, therefore, proportionately full.

The "busy day" is a strenuous affair . . . Few care for a second course: and few who have gone through it will deny that during that course, they have been brought to a normal condition of nerve, self respect, ambition and hope.

I have mentioned "competition" as one of "discipline's" ingredients . . . I will (in parenthesis) explain.

It means professional "work" and health giving "play" at their best.

It acts as a kind of automatic sorter.

It separates the "men" from the "monkeys."

It is a sieve, which lets only the sound man through, and leaves the waster, the man who falls out on the march, who cannot hit a haystack, and trembles at the word "work," for all to see.

Competition in shooting under service conditions, tests of endurance and fitness, are for ever on the carpet.

Men keep themselves fit so that they can represent in some way their sections, in the hope that some day they may have to represent their battalions.

It is the same with play; athletics, football, cross-country running, etc., etc., are carried to an extent which is disastrous to the brewers of ale.

These things call for training, and training fails under the "Wein-Weib-und-Gesang" treatment.

Well! This spirit of competition pervades the detention barrack.

There is no issue of beer.

Tobacco is prohibited.

Silence is observed strictly, and a key is turned in the lock at night.

Nevertheless, the spirit of competition is plainly apparent, and the hangdog look of the "prisoner" is nowhere to be seen.

There is nothing scientific or abstruse about this short article of mine.

It is written with a view to saving such as may have reforms in contemplation, from the drudgery of all drastic changes, from the hard mill of evolution, and to assure them that the planks I have crossed are of sound weight carrying stuff, to be crossed by all who have the welfare of their soldiers and sailors at heart, in perfect safety.

ANNUAL ENGLISH REPORT ON DETENTION BARRACKS.

WAR OFFICE, MAY 6, 1911.

TO THE ADJUTANT-GENERAL TO THE FORCES:

SIR:—I have the honour to submit the Annual Report on Military Detention Barracks and Military Prisons for 1910.

2. *Accommodation.*—Particulars of the accommodation available during the year in all the duly constituted military detention barracks and prisons at home and abroad, except India, are given in Appendices 1, 2, and 3.

3. In consequence of the continued *decrease* in the number of admissions into military detention barracks and prisons, the following establishments were closed during the year:

Curragh Military Prison.

Chatham Branch Detention Barrack.

4. All soldiers sentenced to imprisonment and discharged with ignominy for purely military offences are now committed to Woking Military Prison.

5. The accommodation at Wynberg Detention Barrack has been decreased from 71 to 48 rooms by the demolition of 23 rooms, constructed as a temporary measure during the South African War.

6. An addition of 16 rooms is now being made to Hong Kong Detention Barrack for the accommodation of naval ratings sentenced to detention.

7. The daily average population of regular soldiers in military detention and branch detention barracks and military prisons at home and abroad (excluding India) in each of the years 1904-1910 was as follows:

Year	At home	Abroad (excluding India)	Total	Proportion in 1000 of average strength of Army
1904	1140	402	1542	8.4
1905	803	359	1162	6.1
1906	641	257	898	4.7
1907	598	207	805	4.5
1908	489	166	655	3.7
1909	465	135	600	3.3
1910	379	96	475	2.7

10. The number of soldiers received into military detention barracks and military prisons under sentence of detention and imprisonment by commanding officers and courts-martial was as follows:

Year	Average strength of army at home and abroad (excluding India)	Number of soldiers committed to military detention barracks and military prisons at home and abroad (excluding India) by –								
		Commanding officer's award		Court-martial			General total			
		Detention barracks	Percentages	Detention barracks	Military prisons	Percentages	Detention barracks	Military prisons	Percentages
1904	182,210	14,258	7.8	7,754		4.2	22,012		12
1905	188,570	12,154	6.4	7,307		3.8	19,461		10.2
1906	188,733	9,882	5.2	4,953		2.6	14,835		7.8
1907	175,738	8,486	4.8	4,405	286	2.6	12,891	286	7.4
1908	172,461	7,826	4.5	4,161	309	2.5	11,987	309	7.0
1909	175,810	6,387	3.6	3,704	255	2.2	10,091	255	5.8
1910	174,985	6,136	3.5	2,632	192	1.6	8,960	192	4.11

12. The number of soldiers received into civil prisons in the United Kingdom (including those from the Colonies and India) during the year, and remaining on the 31st December, 1910, was as follows:

Year	Received during 1910		Remaining on 31st December, 1910	
	Military courts	Civil courts	Military courts	Civil courts
	Soldiers convicted under Army Act, section 135, of offences of an immoral, dishonest, shameful or criminal character.		Soldiers convicted under Army Act, section 135, of offences of an immoral, dishonest, shameful, or criminal character	
1910	296	*794	†71	‡115

*1 sentenced to penal servitude.
†21 under sentence of penal servitude.
‡23 under sentence of penal servitude.

13. A further reduction in the establishment of military detention barracks and military prisons has been made, resulting in a decrease of £1000 in Vote 1 (T.) of the Annual Army Estimates.

16. *School Instruction.*—The school instruction has been carried out with satisfactory results. Five certificates of education were obtained during the year by men undergoing detention.

C. F. N. MACREADY, *Major-General,*
Director of Personal Services.

THE DETENTION SYSTEM AND PUNISHMENTS GENERALLY.

(Excerpt from Annual Report of the Secretary of the Navy, 1911.)

In an examination recently made in England into the various features for improving the condition of the British Navy the department was much impressed with the detention system originally started in the British Army and now in use in the British Navy. In these sister services there has been for some time an absolute separation of the men being punished for offences against discipline and those convicted of crime, such as felony, fraud, or scandalous conduct. Men convicted of crime are sentenced to ordinary civil prisons, where their treatment is that given to similar offenders from civil life. All offenders against discipline in these services are punished by detention punishments, which are short and very exacting, but which do not brutalize or degrade the offender. Such men are quartered in detention barracks, with a room for each. Their meals are served to them separately, and they do not at any time converse with each other or with the noncommissioned officers in charge.

Rigid routine of drill and useful work is maintained. The forenoons are passed in military drills, the aim at Aldershot detention barracks being particularly to turn out men who have improved in military drills and marksmanship, so that they will go back to their commands and be more useful than they were before. The afternoons are spent in useful work, or in the repair of articles in general use at the large military camp at Aldershot. The men are also put through a thorough course of military training, including skillful work in the gymnasium, and as they are not allowed tobacco or other stimulants during the time they are under detention the improvement in their physical and mental welfare is most marked.

When it is considered that the period of detention will run from 10 days to 6 weeks, the efficacy of the system may be seen by the results accomplished in such a short time. No prison garb is worn; there is no harshness of tone or manner toward those under detention; and the whole purpose of the system may be said to be to restore moral tone, to improve the physical condition, and to keep every moment of the offender so occupied with rigorous and exacting drills and occupations that he is most anxious never to be punished the second time in this way. The results, as shown in an official report of the British Army, are significant in showing the reduction in the number of offenders and in the greatly reduced accommodations thus made necessary.

By the British Army act of 1906 all army prisons became detention barracks, except two. In the British Army the daily average population of all the detention barracks was, in 1906, 898 men, and in 1910 it had been reduced to 475, this result being accomplished by the detention system and the diffusion of knowledge regarding it in the ranks of the British Army. It is stated by British officers that the system has resulted in a marked decrease in disciplinary offences and crime generally. This is shown by the following figures: In 1907, one year after the system had been generally adopted by the army, 12,891 men were committed to the detention barracks for detention punishment and 286 men were committed

to prisons for criminal offences. In 1910, three years later, 8960 were committed to detention barracks and 192 to prisons. This is a marked reduction in three years.

Not only are the number of offences against discipline reduced, but naval prisons are rendered almost unnecessary, and economy results from the fact that the terms of detention are very short and the number of guards necessary is remarkably small. At the Aldershot detention barracks, where there were about three hundred men under detention at the time of my visit, there was one watchman on duty at a time at night, another watchman relieving him for half the night. During the daytime there were about a dozen noncommissioned officers present, who act as drillmasters and are in charge of men at work. The men are allotted certain tasks, and they get good marks when they improve on the work allotted to them. This feature, with perfect conduct, slightly reduces the length of time they are kept under detention. The commandant of the detention barracks at Aldershot told me that very seldom does a man come back the second time. All the men feel that they are being punished, but that it is quick and short and disagreeable, and they seem reconciled to the fact that they are paying a reasonable, if disagreeable, penalty for what they have done.

A start has been made toward inaugurating the detention system in our Navy, and I propose that the system shall be used in the present naval prisons, providing they can be changed to suit the new conditions. In England the punishment for desertion and absence without leave is by detention. No loss of civil rights accompanies such punishment. In this country an enlisted man convicted of desertion suffers the loss of all civil rights—practically the loss of his citizenship, since he can at no time afterwards hold any public office. I believe that the possibility of this punishment in time of peace should be removed, and so recommend.

In the past year the sum of about $600,000 has been taken from the pay of enlisted men in fines, inflicted by naval courts. This money goes to the naval hospital fund. The men's pay is not any too much as it is, and those convicted of absence without leave and other offences against discipline are frequently fined two weeks' or a month's pay, and frequently as much as three months' pay. For the men whose records or character indicate a possibility of reform short-term, sharp punishments should be provided, so that these men may be returned to duty chastened and better men. For those of bad record or character severe punishment should be inflicted and such men entirely separated from the service as a deterrent to others of like character. The prevention of desertion can also be aided by the prompt and certain apprehension of deserters.

REPORT OF THE INSPECTOR GENERAL OF THE U. S. ARMY, NOVEMBER 25, 1911, ON THE DETENTION BARRACKS, BRITISH ARMY.

About seven years ago, for the purpose of preventing soldiers convicted of offences against discipline under the Army act and not charged with ignominy, from being subjected to the stigma attaching to imprisonment, the Army act was amended so that courts-martial could award detention instead of imprisonment as punishment for military offences.

Under the same act commanding officers can award detention not exceeding 28 days.

Detention barracks were established as follows:

	Rooms.
Aldershot	226
Colchester	63
Devonport	40
Gosport	163
York Castle	114
Cork	102
Dublin	131
Sterling	48
Total	887

Branch detention barracks were established at—

	Rooms.
Chelsea	30
Pembroke Dock	6
Shorncliff	15
Woolwich	32
Jersey	10
Total	93

Since 1910, all soldiers sentenced to imprisonment for purely military offences are now committed to the Woking Military Prison.

The military prison at Curragh and a branch detention barracks at Chatham were closed during the year 1910, in consequence of continued decrease of the number of admissions into military prisons and detention barracks, respectively. Others were established in outlying possessions.

The Regulations of the military prison and detention barracks state:

"The chief object of establishing a prison or detention barracks for military offenders is to maintain discipline in the army and to repress the repetition of military offences; as punishment alone can hardly be expected to produce this effect, he (commandant) shall consider it his duty to endeavor to instill soldierly life and military principles into the mind of every soldier under sentence, letting him see that he takes an interest in his welfare, and by his good advice and kindly admonition endeavor to convince him of his error and to encourage him to aim at future good conduct and

the attainment of a respectable character in the service. Bearing in mind that the soldiers are, in most cases, to return to the colors on release, and that they should be fit at once to resume their places in the ranks, the commandant will pay special attention, not only to the discipline and military training of such soldiers, but also to their bearing and personal appearance."

The strictest military discipline with silence is maintained. Soldiers under sentence are not to talk or communicate with each other. By good conduct, proficiency, attention to military instruction, and industry, a soldier with a sentence of 28 days or upward may earn a remission of sentence not to exceed one-sixth of the whole sentence. To obtain a remission of one-sixth of his sentence he must earn five-sixth of the total marks obtainable during the whole of his sentence. This remission of one-sixth of the sentence is decreased proportionately with the number of times a soldier under sentence has been convicted by court-martial. For example: If convicted twice, by one-twelfth; if convicted three times by one twenty-fourth. In other words, in order to earn a remission, a soldier must earn five-sixths, eleven-twelfths, or twenty-three twenty-fourths, as the case may be, of the total number of marks obtainable during the whole of his sentence.

The total number of marks obtainable in a day is eight.

The promotion of a soldier under sentence from the lower to the higher stage is gained by industry, good conduct, and attention to his drill, but it may be postponed for idleness or misconduct; or he may be removed to the lower stage; or he may forfeit any of the privileges of his stage.

A daily record is kept of marks obtained, and to become eligible for remission, a soldier must earn the required number of marks and, in addition, any marks he may have forfeited for misconduct. He must earn 112 marks before he becomes eligible to the second stage.

A soldier under sentence in the first stage will—

(*a*) Be employed daily on hard bodily or hard manual labor for not more than 10 or less than 6 hours, exclusive of meals; (*b*) sleep without a mattress; (*c*) perform one hour's physical exercise daily; (*d*) be allowed books of religious and secular instruction; (*e*) be allowed exercise on Sunday.

A soldier under sentence in the second stage will—

(*a*) Be employed on work of a less hard description for not less than six hours daily; (*b*) sleep on a mattress every night; (*c*) perform two or three hours' drill and gymnastics daily; (*d*) be allowed books of instruction both religious and secular; (*e*) receive school instruction if eligible under the regulations made for the education of soldiers under sentence; (*f*) be allowed a library book, which may be changed twice a week; (*g*) be allowed exercise on Sunday; (*h*) be allowed to receive and write a letter, and receive a visit of 20 minutes' duration from a friend.

Marks are awarded daily by a thoroughly reliable and responsible member of the staff.

Hard labor consists of breaking stones, or such other like description of hard bodily and hard manual labor as may be appointed.

PUNISHMENTS AGAINST DISCIPLINE IN DETENTION BARRACKS.

The commandant's power is limited to—

(*a*) Close confinement to any period not exceeding 3 days; (*b*) reduction of diet as laid down in the scale of diets for ill-conducted and idle soldiers under sentence; (*c*) reduction from higher stage to lower stage, or postponement of promotion to higher stage for a period not exceeding 14 days; (*d*) deprivation of mattress for any period not exceeding 3 days for idleness or refusing to work; (*e*) forfeiture of remission of sentence for a period not exceeding 7 days.

No soldier under sentence can be put in irons or under mechanical restraint by the commandant except in case of urgent necessity, and the particulars of every such case shall be entered in the commandant's journal.

The military, educational and physical training while in detention barracks is such as to keep the trained soldier efficient and to give elementary training to untrained men.

The course of military training consists in—

(1) Drill, physical exercise, gymnastics, etc.; (2) musketry; (3) signaling (semaphore); (4) lectures on skirmishing and scouting; (5) lectures, explained on a blackboard, on outposts, advance and rear guard; (6) knotting and splicing and lashing spars, making bridges; (7) making field trenches, head cover, and loop holes.

Soldiers sentenced by courts-martial and those under four months' service or who have not fired a recruit's course of musketry, perform musketry drill daily, consisting of firing exercises, aiming, pointing, etc., and they continue to do so until they are fit to fire a course on the miniature range.

Trained soldiers perform one hour's musketry drill at least once a week.

Soldiers under sentence who have been discharged from the army, or who are to be discharged therefrom upon release, will not be practiced in drill or gymnastics or any military training, but are kept at hard work instead.

Soldiers who are under punishment for offences committed in the detention barracks are likewise ineligible for drill, gymnastics, or military training.

Soldiers in detention barracks, in addition to this military training daily, are employed on productive and useful work for the military departments, such as making kit bags, nose bags, stable and linen bags, mattress cases, bed cases, bolster cases, mats of various kinds, head and heel ropes, coal sacks, repairing clothing, bed linen, and equipments of various kinds, remaking beds, bolsters and mattresses, painting kit boxes, buckets, etc., washing bed and bolster cases, hospital kits, clothing and personal linen of soldiers under sentence, cleaning and laquering harness and saddlery and ordnance stores of all descriptions, chopping and bundling kindling wood.

The washing of barrack bedding of all the troops in the London district is now done at the Woking Military prison.

Specially selected noncommissioned officers are appointed for duty in the detention barracks on probation for four weeks; if not found suitable, they are reurned to their corps.

Religious instruction is given by chaplains to those who are willing to receive it. All soldiers under sentence are required to attend divine service on Sunday, and on other days when such service is performed. A chaplain is required to see each soldier separately, occasionally.

School instruction is given to all soldiers under sentence in the second stage who have sentences exceeding 21 days. Such instruction is given between 4 and 8 p. m., and care is taken that the drill is not interfered with, and that the minimum of 6 hours' work is performed by each soldier on every week day.

DAILY ROUTINE.

WEEK DAYS.

5.30 a. m.—Reveille; clean up and prepare for kit inspection.

6.05 a. m.—Check roll call; slops collected; rooms and halls swept; sick list made out.

6.20 a. m.—Kit and room inspected; tasks checked.

6.40 a. m.—Work begins; second stage parade for drill; physical or military training in hot weather.

7.45 a. m.—Breakfast.

8.15 a. m.—Clean equipments, rooms, etc.

8.50 a. m.—"Closeting" removed.

9.15 a. m.—Second stage parade for inspection in marching order for drill and musketry; first stage parade for inspection in marching order and proceed to physical training for one hour.

10.30 a. m.—Second stage gymnastics; first stage recommence work.

11.30 a. m.—Second stage recommence work.

12.30 p. m.—Dinner.

1 p. m.—Clean kit, rooms, and equipment.

1.15 p. m.—All recommence work in rooms.

2.15 p. m.—Second stage parade for physical training or military training (in hot weather work recommences); first stage continue work.

3.15 p. m.—Second stage recommence work.

4.15 p. m.—School for second stage.

5.45 p. m.—School and work cease.

5.50 p. m.—Supper.

6.15 p. m.—Work recommences in room.

8 p. m.—Work ceases; lock up.

9 p. m.—Lights out.

SUNDAYS.

6.30 a. m.—Reveille.

7.45 a. m.—Breakfast.

10.15 a. m.—Divine service.

12.30 p. m.—Dinner.

5.50 p. m.—Supper; lock up.

9. p. m.—Lights out.

SCALE OF PARADES.

MONDAY.

9.15 to 10.15 a. m.—Marching order one hour; route marching carried out.

10.20 to 11.20 a. m.—Physical training, signal exercise, and lecture. Men with sentences of 14 days and under, physical training outside of gymnasium.

11.25 a. m. to 12.15 p. m.—Physical training, gymnasium, signaling and lecture. Men with sentences of 14 days and under, signaling.

1.45 p. m.—Men proceed to work; school instruction.

TUESDAY.

9.15 to 10.15 a. m.—Marching order one hour; company and squad drill.

10.20 to 11.20 a. m.—Physical training, gymnasium; knotting and bridging. Men with sentences of 14 days and under, physical training outside of gymnasium.

11.25 a. m. to 12.15 p. m.—Physical training; knotting and bridging. Men with sentences of 14 days and under, signal drill.

11.45 a. m. to 12.15 p. m.—Men outside of established church proceed to chapel.

1.45 p. m.—Men proceed to work; school instruction.

WEDNESDAY.

9.15 to 10.15 a. m.—All men parade in skeleton marching order for musketry instruction.

10.20 to 11.20 a. m.—Physical training classes, gymnasium; knotting and bridging. Men with sentences of 14 days and under, physical training outside of gymnasium.

11.25 a. m. to 12.15 p. m.—Physical training in gymnasium; knotting and bridging. Men with sentences of 14 days and under, signal drill.

11.45 a. m. to 12.15 p. m.—Men of the established religion to chapel.

1.45 p. m.—Men proceed to work; school instruction.

THURSDAY.

9.15 to 10.15 a. m.—Marching order one hour; squad and section drill; skirmishing.

10.20 to 11.20 a. m.—Physical training, gymnasium; signal drill; lecture and tent pitching. Men with sentences of 14 days and under, physical training outside of gymnasium.

11.25 to 12.15 p. m.—Physical training, gymnasium; signal drill; lecture and tent pitching. Men with sentences of 14 days and under, signal drill.

1.45 p. m.—Men proceed to work; school instruction.

FRIDAY.

9.15 to 10.15 a. m.—Marching order one hour; company and squad drill.

10.20 to 11.20 a. m.—Physical training, gymnasium; signal drill and lecture. Men with sentences of 14 days and under, physical training outside of gymnasium.

11.25 a. m. to 12.15 p. m.—Physical training, gymnasium; signal drill; lecture. Men with sentences of 14 days and under, signal drill.

1.45 p. m.—Men proceed to work; school instruction.

SATURDAY.

9.30 a. m.—Commandant's inspection of barracks; men exercise and then proceed to work.

SUNDAY.

10 a. m.—Men of established religion parade for divine service.

9 a. m.—Roman Catholics, same. Men of other religions as ordered. Exercise for one-half hour in morning and one-half hour in afternoon.

(1) Route marching is carried out at rate of 4 miles an hour.

(2) Men are put in squads for musketry instruction according to their qualifications and their units.

(3) The daily musketry squad is selected as required and includes the standard tests.

(4) Men with sentences of 14 days and under who are proficient in signaling join an advanced class from 11.25 a. m. to 12.15 p. m.

(5) A special squad is formed as required for untrained men, namely recruits, special reserve men, etc. Deserters for a long period also join this squad until considered fit to join the trained one.

(6) Men who have fired a course in detention barracks may be advanced to the trained soldiers' squad when considered fit by the commandant.

(7) Men are advanced to higher classes by order of the commandant. Periodical kit inspections are made by the commandant for parade.

DIETARY (TABLE FARE).

[For sentences of 7 days or under.]

Breakfast.—Daily: Bread, 8 ounces; gruel, 1 pint.

Dinner.—Sunday and Wednesday: Bread, 8 ounces; suet pudding, 8 ounces. Monday and Friday: Bread, 8 ounces; potatoes, 8 ounces. Tuesday, Thursday, and Saturday: Bread, 8 ounces; porridge, 1 pint.

Supper.—Daily: Bread, 8 ounces; gruel, 1 pint.

[Sentences of more than 7 days and not over 42 days.]

Breakfast.—Daily: Bread, 8 ounces; gruel, 1 pint.

Dinner.—Sunday: Bread, 4 ounces; potatoes, 1 pound; suet pudding, 1 pound. Wednesday: Bread, 4 ounces; potatoes, 1 pound; soup (pork and beans), 1 pint. Monday and Friday: Bread, 4 ounces; potatoes, 1 pound; beef or mutton with bone, 8 ounces. Tuesday, Thursday, and Saturday: Bread, 8 ounces; potatoes, one-half pound; soup, 1 pint; cheese, 2 ounces.

Supper.—Daily: Bread, 6 ounces; gruel, 1 pint.

[Sentences for more than 42 days.]

Breakfast.—Daily: Bread, 10 ounces; gruel, three-fourths pint.

Dinner.—Sunday: Bread, 5 ounces; potatoes, 1 pound; suet pudding, 1 pound. Wednesday: Bread, 5 ounces; potatoes, 1 pound; soup (pork and beans), 1 pint; cheese, 2 ounces. Monday and Friday: Bread, 5 ounces; potatoes, 1 pound; beef with bone, 9 ounces. Thursday: Bread,

5 ounces; mutton with bone, 9 ounces; potatoes, 1 pound. Tuesday and Saturday: Bread, 5 ounces; potatoes, 1 pound; soup, 1 pint; cheese, 2 ounces.

Supper.—Daily: Bread, 9 ounces; gruel, 1 pint.

[For badly behaved and idle soldiers.]

No. 1.—1 pound of bread per day, and water.

No. 2. (Stirabout).—Breakfast: Bread, 8 ounces. Dinner: 1 pint stirabout (2 ounces oatmeal, 2 ounces Indian meal, and salt); potatoes, 8 ounces. Supper: Bread, 8 ounces.

The control and general management of the detention barracks and military prisons are under the army council. All orders in connection with inspections, discipline, interior economy, and military training are issued through the director of personal services.

The detention barracks are under the charge of a commandant, generally a field officer, but are under the command of a general, or other officer, commanding the district or station within which the barrack is located, and who inspects the detention barrack from time to time.

An officer, not below the rank of a field officer, is detailed weekly by the general officer (or officer) commanding, as detention-barrack visitor. There is also a board of visitors detailed, that visits the detention barrack at the end of each half year.

I visited the detention barracks at Aldershot on October 13, 1911. This barrack is under the charge of Lieut.-Col. G. Haines, an officer evidently well adapted to the work and who has given many years to it. He stated that the scheme has received the approval of the service and that, with rare exceptions, the soldiers were returned to their regiments good and useful men; that he had received letters from regimental commanders expressing their surprise at what had been accomplished by men sent from their regiments in the way of target instruction. The only change that Col. Haines would suggest in the present scheme was that the punishment awarded first offence of desertion should be at least six months. The sentence now awarded is 28 days for the first offence.

Lieut.-Col. R. A. Henderson, who was inspector general of military prisons and detention barracks in 1906, reported that: "The daily average of soldiers under sentence has decreased about 29 per cent, due to the high state of efficiency and discipline in prisons and detention barracks; to which cause, in addition to the present system of military punishment, the decrease of soldiers under sentence is, in my opinion, in no small degree to be attributed."

The result of the system seems to be to reduce the number of hardened cases to such an extent that it is found best to discharge them from the service rather than to permit them to spread discontent among the soldiers. A large proportion of hard cases are manufactured in prison, and many a man comes out of prison much worse than when he went in. The detention system has the opposite effect, and it is found better to get rid of men who cannot be softened or reformed.

It took five or six years for the detention system in England to establish itself, but it apparently has saved many men from trouble and from degen-

erating into hardened cases. They evidently endeavor in this system to apply humane common sense in the treatment of men in trouble. This gives an opportunity for the men to recover their self respect and respond to any patriotic instinct which, under the stigma of prison life and its demoralizing environment, can not be expected to survive.

The commandant at Aldershot states that he finds a distinct feeling of self respect within the walls of his establishment. This is apparent, in his opinion, from the fact that he observes a keenness to give satisfaction, and to put up a good show when visitors come around, and that the sulky, hang-dog look of the prison is not to be found. This was apparent at the time of my visit.

The commandant states that one sojourn in the detention barracks is generally sufficient, if long enough, to make the soldier useful to his unit. Very few ever return to the detention barrack. He also reported to have known several cases of men being promoted noncommissioned officers for efficiency obtained in the detention barracks.

I was very much impressed with this system as observed at Aldershot.

Soldiers sent to the detention barracks retain their uniform and keep their entire kit, except the rifle, in their rooms. The rifles are issued to them when they turn out for parade. There is no mark or insignia to indicate any idea of imprisonment. The man remains a soldier and is treated as such except that his freedom is restricted and he is detained within specified limits. The effort is to remove the cause for the failure of the man to meet the requirements of the service, to build him up physically so that his nervous system will be in order to respond to the character of instruction and treatment he receives while in these barracks. The majority of the men who come here are sentenced for offences that seem to have their origin in the excessive use of alcoholic liquor, inordinate use of cigarettes, and other indulgences which overtax and wreck the nerves. The effort is to build up the nervous system. For this reason, soldiers detained in these barracks are not allowed to use tobacco at all.

The barrack at Aldershot is located within an inclosure surrounded by a high wall. The barrack is of plain, substantial construction, three stories high, with a central passage extending to the roof, upon which three tiers of rooms open. Each man has a separate room. No conversation is allowed at any time except when it is absolutely necessary in the performance of duty or work.

I saw the men at drill and at work in the shops and in the gymnasium. The work in the gymnasium was excellent and carried on under a gymnastic instructor.

The devices in the yard for target practice were excellent and constructed in a systematic way by means of diagram, etc., on a scale to appear at the short ranges employed as they would appear at the full range, miniature moving targets being used for actual firing.

The fundamental idea controlling the scheme seems to be: Keep the soldier sentenced to the detention barracks employed in useful work, the use of the rifle being very prominent in the scheme.

It will be observed that the "diet" and "separation" play an important part in the scheme of treating soldiers in these detention barracks.

E. A. GARLINGTON, *Inspector General.*

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE AMERICAN NAVY IN THE ORIENT IN RECENT YEARS.

By CHARLES OSCAR PAULLIN.

III.

THE SPANISH-AMERICAN WAR IN THE PHILIPPINE ISLANDS, 1898.

Until 1898 the duties of the Asiatic squadron were chiefly such as fall to ships of war in foreign ports during periods of peace. The squadron was employed in protecting American citizens, redressing injuries inflicted upon them, negotiating treaties, extending our commercial privileges, and exchanging social courtesies with foreign governments. It is true that in prosecuting these employments skirmishes with the natives occurred now and then, and a few of our men were killed or wounded. Our relations, however, with the peoples of the Orient were for many years uniformly peaceful. Suddenly, on the outbreak of the Spanish-American War, this state of affairs was changed, and the Asiatic squadron was ordered to fight and conquer the Spaniards in the Philippine Islands.

In the fall of 1897 the Navy Department chose a successor to Rear Admiral Frederick V. McNair, the commander-in-chief of the Asiatic squadron, whose tour of sea duty was about to expire. From a list of three officers of high rank, it selected Commodore George Dewey, who had been serving as president of the board of inspection and survey.[1] The new commander-in-chief was sixty years of age, forty-three of which he had spent in the navy. Entering the naval academy in 1854, he four years later graduated fifth in a class of fifteen. During the Civil War he saw much service under Farragut and other commanders of the blockading squadrons, and participated in the capture of New Orleans

[1] Long, John D The New American Navy, i, 176-178.

and Fort Fisher. After the war he filled various stations at sea and on shore. In 1889 he was made chief of the bureau of equipment and recruiting, in 1893 a member of the lighthouse board, and in 1895 president of the board of inspection and survey. He received a commodore's commission in 1896. While his career in the navy had been highly creditable, it had scarcely foreshadowed its brilliant consummation at Manila Bay.

Dewey's orders from the department were dated October 21, 1897, and directed him to proceed to Nagasaki and relieve Rear Admiral McNair. Before he sailed from San Francisco for his station, he had collected considerable information respecting the Spanish forces in the Philippines, the policy of the administration had been outlined to him, and he had been instructed respecting his course of action in case of war with Spain.[2] On Christmas day he arrived at Yokohama, and a week later at Nagasaki, where on January 3, 1898, he relieved Rear Admiral McNair. A fortnight thereafter he returned to Yokohama, on his flagship, the protected cruiser *Olympia*, Captain C. V. Gridley, and thence went to Tokio where he was received by the emperor and empress of Japan. On February 11, he sailed for Hong Kong. Of his personal staff, he had already chosen Lieutenant Thomas M. Brumby to be flag lieutenant, and Ensign Harry H. Caldwell to be flag secretary. His chief of staff, Commander Benjamin P. Lamberton, did not arrive on the station until April.

While the possibility of a war with Spain began to influence the action of the department respecting the Asiatic squadron as early as the fall of 1897, it was regarded as more or less remote until the blowing up of the *Maine*, in the harbor of Havana, on the evening of February 15, 1898. Ten days after that catastrophe Assistant Secretary of the Navy Theodore Roosevelt directed Dewey to concentrate his squadron at Hong Kong, to retain the *Olympia*, which had been ordered home, and to keep all the ships of the squadron coaled to their full capacity. "In the declaration of war Spain," Roosevelt cabled, "your duty will be to see that the Spanish squadron does not leave the Asiatic coast, and then offensive operations in Philippine Islands."[3]

[2] Long, John D. The New American Navy, i, 178.

[3] Annual Reports of the Navy Department for the year 1898, Appendix to the Report of the Chief of the Bureau of Navigation, p. 65. This publication will be hereafter referred to as "Reports."

Dewey had a little more than two months in which to prepare for war. The flagship *Olympia,* protected cruiser *Raleigh,* Captain Joseph B. Coghlan, and gunboat *Petrel,* Commander E. P. Wood, were already at Hong Kong. The protected cruiser *Boston,* Captain Frank Wildes, and gunboat *Concord,* Commander Asa Walker, were at Chemulpo, Korea. They were ordered to proceed with all dispatch to Hong Kong. They sailed on the morning of February 28, and so well did they obey orders that by midnight of March 3 they had arrived at their destination. The *Monocacy,* a paddle-wheel steamer of the date of the Civil War, was at Shanghai. Being practically worthless, she was left there, and a part of her officers and crew were detached to fill vacancies on the other ships.

By reason of the prompt efforts of the department to increase the squadron, two other vessels shortly joined it. On April 17 the revenue cutter *McCulloch,* Captain Daniel B. Hodgsdon, arrived at Hong Kong from Singapore, and five days later the protected cruiser *Baltimore,* Captain N. M. Dyer, arrived from Honolulu, bringing a much needed supply of ammunition. Early in March the department had dispatched the old wooden corvette *Mohican* from San Francisco to Honolulu with a load of powder and shells, and she had transferred her cargo to the *Baltimore.* On April 6 Dewey purchased the British freight steamer *Nanshan* together with her cargo of coal, amounting to three thousand tons; and a little later he bought the British passenger steamer *Zafiro,* loading her with a three months' supply of provisions. He also bought another shipload of coal and filled up the bunkers of his vessels, stowing on board the *Zafiro* what was left. In the meantime, the steam machinery of the fleet had been overhauled, the hulls cleaned, and the ships painted a dark slate color, the war dress of the American Navy.

By no means all of Dewey's time was employed in perfecting and strengthening the material of his squadron. In coöperation with his commanders he made a careful study of the military situation in the Philippines, discussed plans of operations, and collected all available information respecting the strength and position of the Spanish fleet and the location of forts and mines. The information regarding the defenses of Subic and Manila bays that he was able to obtain was much less detailed and definite than he wished. He, however, felt confident of victory, as may be seen

from the following extract taken from a letter to his sister, dated April 18, 1898: "We are still waiting for the declaration of war to begin our work here. I have seven men-of-war all ready for action, and should war be the word I believe we will make short work of the Spanish reign in the Philippines. The insurgents are ready to rise at our first gun, and long before this reaches you we may be masters at Manila and other Philippine cities. . . I believe I am not over-confident in saying that with the force under my command, I could enter the bay of Manila, capture or destroy the Spanish squadron and reduce the defenses in one day."[4]

On the morning of April 25 the expected orders from Secretary Long arrived. They were clear, concise, and to the point: "War has commenced between the United States and Spain. Proceed at once to Philippine Islands. Commence operations at once, particularly against the Spanish fleet. You must capture vessels or destroy. Use utmost endeavors."[5]

Already, on the 24th, the governor of Hong Kong had informed the commodore that war existed between the United States and Spain; and, in conformity to the laws of neutrality, had requested him to withdraw his squadron from British waters within twenty-four hours. At two o'clock in the afternoon, the *Boston*, *Concord*, *Petrel*, *McCulloch*, *Nanshan* and *Zafiro* steamed out of Hong Kong harbor, and in the forenoon of the 25th were followed by the *Olympia*, *Baltimore* and *Raleigh*. As the last division left port, with its bands playing the Star Spangled Banner, it was saluted by the ringing cheers of the British soldiers and sailors stationed at Hong Kong, who were aware of the mission upon which the fleet was bound. The vessels were assembled at Mirs Bay, thirty miles distant, in Chinese waters. Here the commodore anxiously awaited the arrival of some machinery for the *Raleigh*, and our consul to Manila, Mr. Oscar F. Williams, who had left Manila on the 23d, after having been repeatedly requested to do so by Dewey. The interval of delay was spent in drilling the seamen and preparing the ships for action by removing from them spars, chests, hatch-covers and other wooden articles.

While the squadron was anchored in Mirs Bay, the first act of war in the Philippines occurred. On April 26, near Iloilo, the

[4] Army and Navy Journal (New York), xxxv, 796; Dewey, A. M., The Life and Letters of Admiral Dewey, 197-198.

[5] Proceedings of the U. S. Naval Institute, xxvi, 491; Reports, 67.

Spaniards captured the American merchant bark *Saranac*, laden with a cargo of Australian coal. Fortunately she was equipped with papers showing a transfer to the British flag, and she was released by the local authorities. The seizure of the *Saranac* was the only attempt made in the Philippines to capture a mercantile prize during the war.[6]

About noon of the 27th a tug from Hong Kong arrived at Mirs Bay with Consul Williams and the *Raleigh's* machinery. A council was immediately held on board the flagship by Dewey and his commanders, being attended by Williams, who brought word that he had left the Spanish squadron in Manila Bay. He gave the commodore all the information that he had been able to gather respecting the defenses of the bay and city of Manila. At 2 p. m. the *Olympia* displayed the signal: "All ships prepare to leave anchorage." They were off promptly on the minute, the flagship leading, and her band playing the inspiring strains of the El Capitan march. The squadron sailed in two parallel lines, the *Olympia, Baltimore, Raleigh, Petrel, Concord* and *Boston* forming one, in the order given; and the *McCulloch, Nanshan* and *Zafiro*, the other. That coal might be economized, it moved at the slow rate of eight knots an hour, to the great annoyance of the sailors who were eager for the fray.

As the ships filed out of Mirs Bay, grim in their dull war-dress, the heart of every man on board of them must have been quickened by the certainty that the cruise would be rich in adventure and dramatic achievement, by the mystery that shrouded its movements, and by a realization of the importance of its mission. In retrospect, we are likely to think that the Spanish fleet was foredoomed to destruction, but such was not necessarily the case. Supported by the land defenses of Manila and well fought, it was abundantly able to give a good account of itself. Nor must one overlook the weak points in Dewey's military situation: seven thousand miles from the nearest home port; no base of supplies except that afforded by two small steamers; a squadron of only six fighting ships and three auxiliaries, the largest of less than six thousand tons, all unarmored; the likelihood of encountering mines on entering a harbor in the Philippines; and the absence of friendly ports to which to retire in case of defeat.[7]

[6] Proceedings of the U. S. Naval Institute, xxv, 268.
[7] Massachusetts Military Historical Society Papers, xii, 373.

During the voyage to Manila Bay, which body of water lies some six hundred miles southeast of Hong Kong, the ships were made ready for battle. All of them were built before the use of wood on warships had been universally condemned. It was therefore found necessary to remove, as far as possible, their wooden fixtures. Bulkheads, ceilings, wainscotings, bunks, furniture and storage chests were thrown overboard. Spare chain cables were wrapped around the vital parts of important mechanisms for protection. Boats, spars, and booms were securely lashed. Hose were connected with the fire plugs and laid along the deck. The guns were loaded, and a supply of ammunition was brought up from the magazines. The men were drilled at their various stations, and numerous other preparations for battle were made.

At dawn on April 30, Cape Bolinao, a headland of Luzon, was sighted, and all that day the squadron sailed southward down the beautiful coast of the island. Early in the morning Dewey signalled the *Boston* and *Concord* to proceed at full speed and explore Subic Bay, some thirty miles north of Manila Bay; and later he dispatched the *Baltimore* to assist them. Before the squadron left Mirs Bay, it was rumored that the Spanish admiral, Montojo, would make his stand in Subic Bay; and the admiral had actually assembled his ships there, but regarding the situation as untenable, he on April 29 returned with them to Manila Bay.

At five o'clock in the afternoon the commodore reached Subic Bay, and was joined by the *Boston, Concord* and *Baltimore,* which ships reported that the Spanish fleet could not be found. While making a reconnaissance of the bay, the *Baltimore* overhauled a Spanish schooner and brought her to by firing a shot across her bow. She was shortly boarded by a boarding party, who returned to the *Baltimore* with her skipper and four men. As the Spaniards did not know that war existed, they and their vessel were released. About sunset, after the squadron had resumed its voyage down the coast, Dewey held a council with his commanders and announced his intention of entering Manila Bay that night.

The entrance to Manila Bay is about eleven miles wide, and is divided into two channels by the island of Corregidor. The north channel is called Boca Chica, and the south Boca Grande. The latter is divided into three divisions by Caballo Island, one mile south of Corregidor Island, and by El Fraile Rock, three miles and

a half south of Caballo Island. Dewey decided to enter by way of the southern channel and to pass between Caballo Island and El Fraile Rock, about a mile from the rock. This passage was defended by three guns on Caballo Island, a like number on El Fraile Rock, a like number on the southern mainland, and probably by some mines. No single decision of Dewey showed greater daring and completer self-possession than that to disregard the Spanish defenses and enter the bay at whatever cost. Doubtless he recalled his Civil War experiences with Farragut when the American fleet ran past Forts Jackson and St. Philip on the lower Mississippi.

The night of April 30 was perfect for the proposed undertaking. A young moon, which would set a little after twelve o'clock gave sufficient light to disclose the entrance to the bay.[1] The fleet approached the Boca Grande in single column, the *Olympia* in the lead. No exposed lights were permitted on any of the ships. At the stern of each vessel, however, there was a hooded light, which served to guide the ship in the rear. About 11 p. m. all hands were called to quarters, and a little later the *Olympia*, followed silently by her consorts, bent her course to enter the Boca Grande. Half the squadron had passed El Fraile Rock before the negligent Spaniards realized the situation. Presently the stern lights of the receding vessels, or else a funnel fire which flamed up on the *McCulloch*, gave the alarm, and the battery on El Fraile Rock opened fire on the fleet, which was returned by the *Boston*, *McCulloch*, *Raleigh* and *Concord*, each vessel firing some two or three shots. No injury was done to the Americans, and probably none to the Spaniards. By half past twelve a. m. of May 1—Sunday morning—the entire fleet was within the bay and slowly steaming toward Manila, thirty miles distant. The men were now permitted to lie down at their quarters, and get a little sleep if they could, and about four o'clock hot coffee was served to them. As day dawned the city of Manila with its frowning battlements was descried directly in front of the squadron, three miles away.

Dewey had expected the Spanish to make their defense under the guns of Manila. Fortunately for him, they chose a far weaker position at Cavite, nine miles from the capital, where there was a naval arsenal and several shore batteries. The adoption of these faulty tactics by the enemy was a result of his deter-

[1] Proceedings of the U. S. Naval Institute, xxvi, 498.

mination to save Manila from bombardment. Disappointed at not discovering the Spanish fleet at the capital, Dewey swung round to the southward and headed toward Cavite. Already the batteries at Manila had opened fire on him, but they did no damage. Only the *Boston* and *Concord* replied. As day dawned Montojo's fleet was dimly discerned in the distance anchored in an almost direct east and west line off Cavite, across the mouth of Cañacao Bay, and to the east of the peninsula on which Cavite is situated. The left of Montojo's line was not far from Sangley Point at the head of the peninsula, where two guns were mounted. A mile southwest of Sangley Point, at Cañacao, there was a battery of one gun, and at Cavite there were three guns. Montojo's fleet contained the following vessels: the *Reina Cristina* (flagship), *Castilla, Isla de Cuba, Isla de Luzon, Marques del Duero, Don Antonio de Ulloa* and *Don Juan de Austria.*[*]

About the time Manila was sighted the *Olympia* signalled to her consorts "Prepare for general action"; then a little later, "Form in single column"; and then, "Close up." Already the *McCulloch, Nanshan,* and *Zafiro* had been detached and ordered to take a position somewhat remote from the scene of battle. The six fighting ships approached Cavite in the following order: *Olympia, Baltimore, Raleigh, Petrel, Concord,* and *Boston.* The commodore and his staff stood upon the bridge of the *Olympia.* While advancing to the attack, two mines exploded some distance ahead of the flagship, too far away to do any damage. Long before the fleet was within range, the battery on Sangley Point began firing, and a little later Montojo ordered his ships to open fire. About 5.40 a. m. Dewey answered the Spanish guns, at a distance of about five thousand yards. The battle then became general, and continued almost two hours. The American squadron passed down in front of the Spanish line, turned, and passed up; and then repeated this movement, firing alternately the port and starboard broadsides. At each turn it drew nearer the enemy, until finally it was within two thousand yards of him. Five times it sailed along his line. At the outset the firing of the American ships was inaccurate, but it steadily improved. The firing of the enemy was remarkably bad throughout the fight, his projectiles either falling short or passing over the vessels of his adversary.

Early in the action two launches put out from shore toward the

[*] Reports, 90.

Olympia, apparently with the intention of firing torpedoes. One of these the Americans sank, and the other they disabled and beached.[10] Montojo's flagship was a particular target for the American guns, and she was one of the first of his vessels to be struck. Soon after the fight began a shell exploded in her forecastle, killing and wounding several men and splintering her foremast. Shortly, another shell set fire to the crews' bags on the orlop deck. A third shell completely disabled her steering gear. Then the stern of the vessel was struck and nine men put out of action. Next the mizzenmast fell bringing down the flag and ensign. A shell exploded in the officers' cabin, covering the hospital that had been established there with blood and killing the wounded seamen. A second shell exploded in the ammunition room, which was set on fire, and still another shell exploded on deck setting fire to the ship at that point. Montojo fought his vessel until she was ablaze from stem to stern. During the action he stood upon the bridge, cool and self-contained. Finally he was compelled to abandon the *Reina Cristina.*[11] "The ship being out of control," he wrote, "the hull, smoke pipe, and mast riddled with shot or confused with the cries of the wounded; half of her crew out of action, among whom were seven officers, I gave the order to sink and abandon the ship before the magazine should explode, making signal at the same time to the *Cuba* and *Luzon* to assist in saving the rest of the crew, which they did, aided by others from the *Duero* and the arsenal. I abandoned the *Cristina,* directing beforehand to secure her flag, and accompanied by my staff, and with great sorrow, I hoisted my flag on the cruiser *Isla de Cuba.* After having saved many men from the unfortunate vessel, one shell destroyed her heroic commander, Don Luis Cadarso, who was directing the rescue."[12] The *Reina Cristina* lost one hundred and thirty men killed and ninety wounded, one-half her crew; among the former were seven officers, including her captain. She was finally sunk and abandoned by the Spaniards.

Next to the flagship, the *Castilla* received the hottest fire. She was gallantly fought, and after all her guns except one had been

[10] Reports, 70. For differences of opinion respecting these boats see H. W. Wilson's, The Downfall of Spain, 134.

[11] Dewey, A. M. The Life and Letters of Admiral Dewey, 428.

[12] Reports, 91-92.

put out of action, that one was still served by her crew. Finally having been riddled with shot and set on fire, she too was sunk and abandoned. Her casualties were twenty-three killed and eighty wounded, one of her officers being among the former. The *Don Juan de Austria* was much damaged and was set on fire; the *Isla de Luzon* had three guns dismounted; and the *Marques del Duero* received severe injuries.

At 7.35 a. m., having been informed that only fifteen rounds a gun for the 5-inch rapid-fire batteries of the flagship remained, Dewey ordered the vessels to cease firing and withdraw from the action, intending to redistribute the ammunition and confer with his commanders. When he gave this order he was not aware that his fleet had practically escaped injury and that the major part of the Spanish fleet had been virtually rendered useless for further fighting. On the withdrawal of Dewey, Montojo ordered his vessels to retire into the inner harbor of Cavite, behind the arsenal and there resist to the last, and to be sunk rather than surrender.

During the engagement, the batteries at Manila kept up a continuous fire, although too far away to do any damage to the American ships. Dewey now sent a messenger to the governor-general to inform him that unless the fire ceased the city should be shelled. This had the desired effect, and the batteries were immediately silenced. On conferring with his commanders, Dewey learned that the information respecting the rapid expenditure of ammunition was erroneous. He therefore, after breakfasting his crews, ordered the squadron to return to the attack.

This time the ships approached the enemy from the south-southwest, steaming toward the batteries on Sangley Point. The *Baltimore* was in the lead, and was followed, in order, by the *Olympia, Raleigh, Boston, Concord,* and *Petrel.*[13] Only the shore batteries, and the ship *Don Antonio de Ulloa* which lay inside Sangley Point were in condition to participate in the second engagement. The *Reina Cristina* and *Castilla* were burning in the outer harbor of Cavite. The *Don Juan de Austria, Isla de Cuba, Isla de Luzon,* and *Marques del Duero,* together with several other vessels, were in the inner harbor behind the Cavite arsenal. The second fight began about 11 a. m. and continued until 12.30 p. m.

[13] The Century Magazine (New York), lvi, 616.

When the order to renew the battle was given by Dewey, the *Baltimore,* happening at the time to be chasing a British merchant ship, was two miles nearer the enemy than the other ships of the squadron, and was therefore able to engage him first. Taking a position twenty-eight hundred yards off Sangley Point she opened fire with her starboard broadside upon the shore batteries and the *Don Antonio de Ulloa.* Going dead slow, she gradually reduced her distance to twenty-two hundred yards, and having obtained the range stopped her engines. She inflicted much damage before the rest of the ships came to her assistance. The batteries were speedily silenced and the *Ulloa,* having received several shots on the water line, went down, her flag flying, the survivors of her crew escaping to the shore. Her loss was eight men killed and ten wounded, her captain and two other officers being among the former.[14]

Early in the fight the *Concord* was sent around Sangley Point to destroy the *Isla de Mindanao,* a transport. Arriving within twenty-five hundred yards of that vessel, she opened fire, and the crew abandoned their ship almost immediately. Soon the *Mindanao* was a mass of flames. In the meantime the *Petrel* had entered the outer bay and had begun firing on the ships in the inner harbor, whose masts were visible above the government buildings at Cavite. She had fired only two or three shots when the Spanish flag on the arsenal sheers was hauled down, and a white flag, a sign of surrender, was run up. The *Petrel* at once signalled the news to Dewey, who on receiving it ordered his ships to cease firing. The second engagement came to an end with this order.

Already Montojo had directed the vessels in the inner harbor to be sunk. "There remained," he said, "the last recourse to sink our vessels, and we accomplished this operation, taking care to save the flag, the distinguishing pennant, the money in the safe, the portable arms, the breech plugs of the guns, and the signal codes. After which I went with my staff to the Convent of Santo Domingo de Cavite to be cured of a wound received in the left leg, and to telegraph a brief report of the action."[15]

[14] According to the Spanish account the *Ulloa* was sunk in the first engagement. See Reports, 73, 75, 92.

[15] Reports, 92.

When a party of men from the *Petrel*, under orders to burn the Spanish fleet, arrived in the inner harbor, it found the *Isla de Cuba*, *Isla de Luzon* and *Don Juan de Austria* aground and full of water. It set fire to these ships and to the *Marques del Duero* and *General Lezo*. A second party burned the *Velasco*. A third party brought off the two tugboats *Rapido* and *Hercules* and three launches.[18] The hydrographic survey vessel *Argos* was also burned. The coast survey ship *Manila*, on the request of some Spanish officers, was spared. At 5.20 p. m. the *Petrel* got under way to join the flagship. By the evening of May 1, the squadron, having literally complied with its orders to capture the Spanish vessels or destroy them, had completed its work and lay at anchor off Manila.

The total loss on board the Spanish fleet was one hundred and sixty-one men killed and two hundred and ten wounded. Among the killed were eleven officers. Admiral Montojo was wounded in the leg. Six men were killed and four wounded in the shore batteries. The total loss of the fleet, three hundred and seventy-one men, was one-fourth the number engaged, almost if not quite the heaviest loss ever inflicted in a squadron action. Not a man was killed on board the American ships, and only nine wounded, and those but slightly.

The Spanish lost twelve vessels sunk and burned, and two captured; and they had three shore batteries silenced. The Americans lost not a vessel. So bad was the marksmanship of the enemy that Dewey's fleet was in practically as good fighting trim at the end of the battle as at the beginning. The *Concord* had not been hit, and the *Raleigh* and *Petrel* but once each. The *Boston* was hit four times, and the *Olympia* a half dozen or more times. The *Baltimore* received most injury, being struck by five shots. A ventilator, a gun, a bunker, and the exhaust pipe of her starboard blower were damaged. One shot, the first that struck the vessel, exploded some ammunition, slightly injuring two officers and six men—almost the only casualties on board the fleet.

The unequal damage inflicted by the two squadrons is in large part ascribable to the poor marksmanship of the enemy and to the superiority of the American fleet, which had the advantage over its antagonist in tonnage, number of men, and number and

[18] Reports, 81.

size of guns. In the first engagement, which practically decided the battle, six American and seven Spanish ships participated. The total tonnage of the American ships was 19,000 tons, and of the Spanish 11,500 tons. The total number of men on the American ships was 1611, and on the Spanish 1497. Dewey's guns, counting only the larger ones, were 53 in number, Montojo's 37.[17] Dewey's largest were ten 8-inch guns, and Montojo's seven 6.2-inch guns. The superiority of the Americans, however, was somewhat reduced by the Spanish shore batteries, mounting six or more guns. Only one of these appears to have played much part in the first engagement.[18] If we count the Spanish forces on shore, Montojo's men exceeded Dewey's.

On the morning of May 2 the fleet returned to Cavite where it now established its headquarters. A landing party was sent ashore to destroy the batteries at Sangley Point and Cañacao; and the cable to Hong Kong was cut, since the governor-general refused Dewey the use of it. On the 3d the Spanish forces evacuated the Cavite arsenal and the Americans took possession. On the same day the *Raleigh* and *Boston* received the surrender of the fortifications at the entrance of Manila Bay and destroyed their guns. As it was impracticable for Dewey to guard and subsist prisoners, he parolled them and permitted them to make their way to Manila. He also sent the wounded Spaniards to Manila, with their surgeons and nurses, under a flag of truce. A guard of marines was stationed at Cavite to protect the public property. On the afternoon of the 5th the *McCulloch* was sent to Hong Kong to cable home an account of the work of the fleet, which duty was performed by Lieutenant Brumby on the 7th, almost a week after the battle.[19]

The news of the glorious victory aroused much enthusiasm in the United States, and Dewey at once became the hero of the nation. President McKinley made him a rear-admiral and, in the name of the American people thanked him, his officers, and his men for their great achievement. On May 10, by joint resolution, Congress tendered its thanks to him and his squadron;

[17] Neeser, R. W. Statistical and Chronological History of the United States Navy, i, 250-251. The numbers of men engaged are from Mr. Neeser's book. See also Reports, 72, 109.

[18] Reports, 91.

[19] Massachusetts Military Historical Society Papers, xii, 383-387; Reports, 71-72; U. S. Revenue Cutter Service in the War with Spain, 15.

and on June 3 it voted to him a sword of honor, and to his officers and men bronze medals. On March 2, 1899, it revived the grade of admiral, previously filled by only Farragut and Porter, and on the same day Dewey was promoted to the new rank. All his chief officers were advanced from two to ten numbers in their respective grades for eminent and conspicuous conduct in battle.

Having destroyed the Spanish fleet and made himself master of Manila Bay, Dewey turned his attention to Manila, which was well defended by more than thirty guns, thirteen of them larger than the largest guns of the American fleet,[20] and by some ten thousand Spanish troops. He felt able to capture the city as soon as his ammunition was replenished; but, since he had not sufficient means to hold it, he decided to await the arrival of reinforcements from home. On May 13 he wrote as follows to the Secretary of the Navy: "I can take Manila at any moment. To retain possession and thus control Philippine Islands would require, in my best judgment, well-equipped force of 5000 men."[21]

Soon after the battle of Manila Bay the commodore and the governor-general agreed that neither should open fire upon the other, and henceforth the American ships were free to move about off Manila without risk of being fired on by the fortifications of the capital. To prevent the enemy from receiving supplies, Dewey established a strict blockade off Manila, the maintenance of which was his principal duty during the three months that he patiently waited for reinforcements. The squadron established itself at Cavite, where it fitted out a repair shop and naval depot. It was kept in touch with the government at Washington by means of the *McCulloch* and *Nanshan*, which were used as dispatch boats to ply between Cavite and Hong Kong. The prize transport *Manila* was commissioned and added to the fleet. On May 12 the gunboat *Callao* was taken while attempting to run the blockade, and she also was commissioned. On June 29 the *McCulloch* captured the Spanish gunboat *Leyte*, which was returning to Manila with a load of refugees.

For some weeks after the battle of Manila Bay, Dewey's position in the Philippines was by no means secure, and he was greatly embarrassed by several trying circumstances. About the middle of June a Spanish fleet of twelve vessels under Admiral

[20] Proceedings of the U. S. Naval Institute, xxvi, 279.
[21] Reports, 97–98.

Camara, considerably stronger than Dewey's fleet, sailed from Spain for the Philippines by way of the Suez Canal. On the arrival of Camara in the islands, the naval superiority would pass to the Spanish, unless in the meantime the Americans should be reinforced. Dewey planned, in case the Spanish fleet arrived before his reinforcements, to leave Manila Bay and sail eastward to meet them and then return and fight the enemy. The destruction of Cervera's fleet at Santiago caused the recall of that of Camara after it had passed through the Suez Canal, and thereby removed one of Dewey's annoyances.

Another source of trouble was the Filipino insurgents. The insurrection against Spanish rule in the islands that began in 1896 was greatly encouraged by Dewey's victory. On May 19, 1898. Emilio Aguinaldo, an exiled leader of the insurgents, returned to Cavite on board the *McCulloch* and at once put new life into the insurrection by organizing an army and government. He received encouragement from Dewey who furnished him with arms, but who refused to coöperate with him or to bind the American government to support him. It was not long before Aguinaldo and his followers began to embarrass the Americans. With accurate prevision of the future, Dewey wrote as follows on July 26: "Merritt's most difficult problem will be how to deal with insurgents under Aguinaldo, who has become aggressive and even threatening toward our army."[2]

Soon after the battle of Manila Bay Japan and the leading European nations sent one or more ships to the bay to protect their interests in the Philippines.

The receipt at Washington of the news of Dewey's victory of May 1 found the government unprepared to meet the emergency that had arisen in the Philippines. With much energy and dispatch, however, it immediately made arrangements to send out a land force and several naval vessels. Two months elapsed before the first reinforcements arrived at Cavite. In expectation of their arrival Dewey sent the *Baltimore* to Cape Engaño to convoy them to port. On June 30 the little fleet consisting of the cruiser *Charleston*, Captain Henry Glass, and three army transports, reached their destination. On her way out the *Charleston* stopped long enough at the Ladrone Islands to seize the coaling station of Guam. She was loaded with ammunition for the

[2] Reports, 118.

squadron. On July 17 the second expeditionary force, and on the 30th the third, arrived at Cavite. The commander of the American army, Major-general Wesley Merritt, reached Cavite on the 25th. On August 4 the squadron was further strengthened by the arrival of the ironclad monitor *Monterey* and the collier *Brutus*. The military forces in the Philippines were then regarded as quite sufficient to hold Manila. Dewey's long period of anxious waiting was about to come to an end.

Hemmed in by the fleet and by Merritt's army and the army of the insurgents, the Spaniards were in a critical position. Their food had been reduced chiefly to rice and horse flesh, the supply of which however was abundant. Aguinaldo had cut off part of their supply of water, and much sickness prevailed in the city. Their troops, regular and irregular, numbered about thirteen thousand. The American land forces numbered about ten thousand, and the insurgents about fifteen thousand. The arrival of the *Monterey* shifted the advantage in calibre of guns to Dewey, as she carried two 12-inch and two 10-inch guns, while the largest Spanish cannon were four 9.5-inch breech-loading rifles.

The Spanish were still anxious to prevent the bombardment of their city, and the Americans wished if possible to capture it without a useless destruction of life and property. With this in view informal negotiations were conducted by Dewey with the governor-general, by means of the Belgian consul, in the latter part of July.[23] On August 7 Dewey and Merritt sent a joint note to the governor-general notifying him that operations against Manila might begin within forty-eight hours, and asking him to remove his non-combatants. He replied that he had no places of refuge for them. On the 9th the American commanders demanded the peaceful surrender of the city and of the armed forces therein, urging the governor-general to prevent a useless sacrifice of life. "Every consideration of humanity," they said, "makes it imperative that you should not subject your city to the horrors of a bombardment."[24] The governor-general asked that time be given him to consult his home government, but his request was peremptorily refused. He now let it be known that the honor of Spain and the Spanish army would be satisfied with

[23] McClure's Magazine (New York), vii, 171-183.

[24] Annual Reports of the War Department for 1898, i, 47.

a simulated battle and that he would make only a nominal resistance.[25] The American commanders, however, took no chances, and prepared their forces for a stubborn fight should it be offered them.

A combined attack of the army and navy was planned for the 10th, and the navy was disappointed that it did not then occur. The army however needed more time for preparation, and the 13th was finally fixed upon. About nine o'clock in the morning of that day the army and navy began to move toward Manila, the navy steaming over from Cavite. The army advanced to the southern suburbs of the city, marching in two divisions, one commanded by General Greene and the other by General MacArthur. The several ships of the navy were assigned various duties. The *Zafiro* served as the flagship of General Merritt. The *Callao* and *Barcelo* (a captured tug) stood close in shore to support the troops under Greene. The *Monterey, Boston, Charleston, Baltimore* and *McCulloch* took positions covering the defenses of the city to the northward of Malate, situated on the coast in the southern suburbs. The *Olympia,* with Dewey on board, *Raleigh* and *Petrel* covered the defenses at Malate, distant therefrom about three thousand yards.

At about 10 a. m. the three last named vessels and Greene's troops opened fire upon Malate. The fort at that point fired but a single shell, and the forts to the northward did not fire at all. Neither did Dewey's ships to the northward fire. The troops, however, encountered some resistance. At about 10.30 a. m. the *Olympia, Raleigh* and *Petrel* ceased firing, and Greene's men took possession of the fort at Malate. Both divisions of the army now advanced on Manila, and about eleven o'clock a white flag was displayed at the southwest bastion of the city wall, a signal that the Spanish had surrendered.

Soon Lieutenant T. M. Brumby representing Dewey, and Lieutenant-Colonel C. A. Whittier representing Merritt went ashore, Brumby taking with him the *Olympia's* largest flag, which he intended should displace the Spanish colors. These two officers were soon followed by Merritt who proceeded to the palace of the governor-general to confer with him. At 3 p. m. Dewey's ships anchored off Manila, and an hour later the Second Oregon

[25] The Century Magazine, lvii, 936; Barrett, John, Admiral George Dewey, 144; Proceedings of the U. S. Naval Institute, xxv, 304.

Regiment was landed to serve as a provost guard. About five o'clock the American and Spanish generals signed preliminary terms of capitulation, and shortly thereafter the Spanish colors on the sea front were hauled down, and the flag of the victors was hoisted by Lieutenant Brumby, and was saluted with twenty-one guns from each ship of the squadron. Before the close of the day a considerable army of American soldiers were within the city, and a party of army generals had dined in the palace vacated by the governor-general and had smoked their cigars in the lofty rooms of viceroyalty, hung with splendid old portraits of Spain's rulers in the Philippines.[20]

The navy suffered no losses of any kind. The army had five men killed and forty-three wounded. The loss of the Spanish must have been much greater. The Americans captured some thirteen thousand prisoners, twenty-two thousand small arms, ten million rounds of ammunition, about seventy pieces of modern artillery, several hundred ancient bronze pieces, an elaborate fortification of the Vauban type with nearly three miles of parapet, an outer line of field defenses nearly seven miles in length, a city of about three hundred thousand inhabitants, and nine hundred thousand dollars of public money.[21]

On the day after the surrender a commission composed of American and Spanish officers, Captain B. P. Lamberton representing the navy, settled the final terms of capitulation, and General Merritt issued a proclamation establishing a military government over Manila. Dewey at once raised the blockade and opened the city to commerce. He appointed Captain Henry Glass captain of the port, who soon cleared away the obstructions in the Pasig River placed there by the Spanish, and reestablished the lights and aids to navigation. On August 16 Merritt received a cablegram containing the text of President McKinley's proclamation directing a cessation of hostilities, which he at once published.

On August 21 President McKinley cabled congratulations to Dewey, as follows: "Receive for yourself and the officers, sailors, and marines of your command my thanks and congratu-

[20] Reports, 119; Stickney, J. L. Life and Glorious Deeds of Admiral Dewey, 114; Annual Reports of the War Department for 1898, i, 43; Army and Navy Journal, xxxv, 1053; Scribner's Magazine, xxiv, 687.

[21] The Century Magazine, lvii, 931.

lations and those of the nation for the gallant conduct all have again so conspicuously displayed."[28] The Spanish-American War in the Philippines was at an end.

IV.

CHIEF EVENTS SINCE THE SPANISH-AMERICAN WAR, 1898-1910.

By the treaty of peace which brought to an end the Spanish-American War the United States acquired the Philippine Islands. This acquisition had a far-reaching effect on the navy in the East Indies and the Far East. The navy was now provided with a permanent base for operations in Asiatic waters, and was rendered in a measure independent of the naval facilities at Hong Kong, Shanghai, and Yokohama. The duties of the Asiatic squadron were greatly increased, and as a result its size was much augmented. To the old center of its activities, China-Japan, was added a new center, the Philippine Islands.

To meet the changed conditions on the Asiatic station, the squadron, in 1900, was divided into two divisions: the northern squadron, for service in the northern waters of the station; and the southern squadron, for service in the Philippines. In the following year each division was given a squadron commander. In 1907, in accordance with the Navy Department's policy of concentrating its fleets, the Asiatic and Pacific squadrons were consolidated into the United States Pacific Fleet, with headquarters at San Francisco. The new fleet consisted of three squadrons and two torpedo flotillas. Two squadrons and one flotilla were stationed in Asiatic waters.

The commanders-in-chief of the Asiatic squadron, their principal flagships, and their periods of service, from 1898 until 1907, were as follows:

Admiral George Dewey, *Olympia*, 1898-1899.
Captain A. S. Barker, *Oregon*, 1899.
Rear Admiral J. C. Watson, *Baltimore* and *Brooklyn*, 1899-1900.
Rear Admiral G. C. Remey, *Baltimore*, 1900-1902.
Rear Admiral Frederick Rodgers, *New York*, 1902.
Rear Admiral Robley D. Evans, *Kentucky*, 1902-1904.
Rear Admiral P. H. Cooper, *Wisconsin*, 1904.

[28] Quoted in J. L. Stickney's Life and Glorious Deeds of Admiral Dewey, p. 116.

Rear Admiral Yates Stirling, *Wisconsin*, 1904-1905.
Rear Admiral William Folger, *Baltimore*, 1905.
Rear Admiral C. J. Train, *Ohio*, 1905-1906.
Rear Admiral W. A. Brownson, *West Virginia*, 1906-1907.

After the Spanish-American War Cavite became the principal naval station of the squadron in the Philippines. Here were situated repair shops, storehouses, officers' quarters, barracks, and a temporary naval hospital. The station, however, was deficient in many particulars, most especially in docking facilities and requisites for repairing the larger vessels. In 1905, however, it was employing more than three thousand men. In that year a permanent naval hospital was constructed at Cañacao, about a mile from Cavite. In 1899 headquarters for the marines in the Philippines were established at Cavite, and during that and the two following years small detachments of marines were detailed as guards and garrisons at no less than nineteen places in the archipelago.[29] Coaling stations were maintained at Cavite, Isabela de Basilan, Cebú, and Polloc.

Before 1898 the Spanish had begun the construction of a naval station at Olongapo in Subic Bay, a situation regarded by them as superior to Cavite in Manila Bay. Soon after the ratification of the treaty of peace, the establishment of a naval base in the Philippines, adapted to the defense of the islands, came up for consideration. Admiral Dewey and several naval boards reported that Olongapo was the proper place for a great naval station. The army recommended Cavite. For several years this difference of opinion caused a deadlock, and Congress failed to make a selection. In 1905, however, that body appropriated upwards of a million dollars toward the improvement of Olongapo, and in the following year the Dewey drydock was established there. In the meantime the success of the Japanese in their war with Russia, and their naval supremacy in Asiatic waters, somewhat modified the strategic problems involved in the defense of the Philippines. In 1909 a joint army and navy board recommended the maintenance of a small docking and repair station at Olongapo and the establishment of the main base for the Pacific at Pearl Harbor, Hawaii. This recommendation has been approved by the Secretary of the Navy.

[29] Collum, R. S. History of the U. S. Marine Corps, 382.

The effect of the Spanish-American War and the events immediately succeeding it on the size of the Asiatic squadron may be seen from the following figures giving the number of vessels in the squadron on January 1, for the six years 1898-1903: 1898, 6; 1899, 30; 1900, 35; 1901, 52; 1902, 48; 1903, 28. The large increases made in 1899-1901 were caused by the Philippine insurrection and the relief expeditions to Peking. For the four years following the insurrection, which came to an end in 1902, the average number of vessels in the squadron was twenty-six. Many of the vessels added to the fleet during the insurrection were small gunboats adapted for blockade duties.

It is probably too early to write a full account of the Philippine insurrection and the relief of the foreign legations at Peking. Many of the requisite documents still lie buried in the official archives, and are more or less inaccessible to students. The Navy Department has been somewhat negligent in publishing the reports of its officers, and some of its officers have been negligent in reporting their operations. It is possible, however, to describe the work of the navy in China and the Philippines in a more or less general and cursory way. This much only will be here attempted.

The Philippine insurrection began on February 4, 1899, with an attack by the insurgents on the American line outside of Manila.[29] Thence it spread over Luzon, and thence to the islands to the southward thereof. The leading part in the war was of course played by the army, and the minor part by the navy. The work of the latter service consisted chiefly in maintaining a blockade of the ports and coasts of the archipelago, in shelling the fortifications of the enemy, in taking possession of captured towns, in sending ashore landing parties to aid the army, in conducting exploring expeditions around the coasts and through the islands, in convoying army transports, and in disembarking troops.

In 1899 the navy's most important operations were conducted near Manila, on the west and north coast of Luzon, and in the islands of Panay, Cebú and Mindanao. In the engagements near Manila in February and March, 1899, Dewey's vessels in the bay frequently shelled the insurgents on shore, and coöperated

[29] For the Philippine insurrection, see R. W. Neeser's Statistical and Chronological History of the United States Navy, vol. ii, pp. 268-281, 468-471; and the references there given.

with the army with excellent results. A small detachment of marines, under Ensign Cleland Davis, advanced with the troops under General MacArthur and fought with great gallantry. On March 4 a party that was sent ashore at Malabon to take some photographs showing the effect of gun-fire, had a lively skirmish with the enemy. About the middle of June nine ships coöperated with the army in a movement near Cavite, during which a party of ninety men from the *Helena* and *Monadnock* landed and rendered valuable assistance. On October 3 a detachment of sailors and marines participated in the general advance of the army toward Imus. Five days later a force of three hundred fifty-six marines, under the command of Lieutenant-Colonel George F. Elliott, attacked the insurgents near Novaleta, and captured the town. The insurgents had eleven men wounded. This was the last important operation of the navy near Manila in 1899.

To the northward the principal naval operations were in Subic Bay and Lingayen Gulf and at Vigan. On September 14 the *Charleston,* Captain G. W. Pigman, bombarded a fort in Subic Bay and landed a detachment, which took possession of it and destroyed its guns. Later in the same month the *Monterey, Charleston, Concord,* and *Zafiro* were operating in the same waters, and under the cover of their guns, a detachment, commanded by Lieutenant J. D. McDonald, went ashore and destroyed one of the enemy's cannon. In December the *Oregon* and *Baltimore* took possession of the navy-yard at Olongapo, and a marine force was stationed in the town as a garrison.

The campaign in Lingayen Gulf began in March, when the *Baltimore* shelled some of the enemy's works. In September the *Paragua* engaged the enemy from the gulf and silenced his fire, and in November five gunboats and a transport covered the landing of General Wheaton's army at San Fabian.

The capture of Vigan, on the northwest coast of Luzon, was one of the important operations of the year. On November 26, after the *Oregon, Callao,* and *Samar* had driven the insurgents from their trenches about three miles from Vigan, a detachment consisting of one hundred ninety-two sailors and marines, under the command of Lieutenant-Commander Alexander McCracken, was landed. Its movements on reaching the beach are thus described by its commander.

"The column was formed, with the marines as an advance guard, they having been landed first and deployed, and started towards Vigan. There was no opposition, and nearly all the houses displayed white flags. As we neared Cavayan, where an American flag had been hoisted on the church tower, a delegation, carrying the American flag and white flags, came towards us, beating drums to attract our attention; it proved to be the chief officials of the town, who expressed their gratification at our arrival, and a desire to have us take possession of the country. Intrenchments were discovered as we approached Vigan, but they were deserted.

"When we arrived on the outskirts of Vigan we were met by a kilas that contained Mr. A. Sonnichsen and civil officials from Vigan. They came out to tell us that the President of the Province with all the officials were at the Bishop's palace to welcome us to Vigan. Soon after, a brass band of native musicians met us, and was placed at the head of the column. The streets were lined with people who carried white flags and cheered loudly for the Americans.

"Upon our arrival at the Plaza we found the Presidente Provincial, Mr. Mariano Acosta, and the other officials, drawn up in line in front of the Bishop's palace to welcome us. The Presidente presented a letter of welcome in English, which, with a list of the officials, was forwarded to you immediately. The American flag was hoisted over the Bishop's palace, the battalion presenting arms, at 12 o'clock noon by the tower clock in the Plaza. We were also met by many Spanish prisoners, who met us with every sign of joy. The battalion was quartered in the barracks lately deserted by the insurgent troops, but was later on in the afternoon transferred to more suitable quarters in the Bishop's palace. . . . The Presidente was directed to administer his office as before our arrival, except that grave cases were to be referred to the Commanding Officer."[11]

On the following day McCracken made a reconnaissance to the eastward of Vigan, and discovered an insurgent outpost with which he exchanged several shots. He also cut the telegraph wires leading into the interior, and he sent the captured Spanish prisoners to the *Oregon*. On the arrival of a company of U. S. infantry, on the 28th, he turned the town over to the commander of the troops, and withdrew his forces.

[11] U. S. Navy Department, Bureau of Navigation, Files 202555.

In the latter part of the year several vessels patrolled the north and northwest coast of Luzon. On September 14 the *Monterey* and *Concord* captured two schooners at Aparri. In December the *Wheeling* and *Panay* were coöperating with the army on the northwest coast.

To the southward of Luzon the most important naval operations in 1899 were at Panay, whose capital Iloilo was the second port in the archipelago. In the capture of this port the naval vessels *Boston*, Captain G. F. F. Wilde, and *Petrel*, Commander C. C. Cornwell, coöperated with a division of the army under General Miller. On February 10, Miller addressed an ultimatum to the insurgents at Iloilo demanding their withdrawal before sunset of the following day and forbidding them to erect additional defenses under penalty of bombardment. On the morning of the 11th they began to improve their defenses; and the *Boston* and *Petrel* opened fire on them, and forced them to abandon their guns and retreat. A landing party, drawn from both vessels and commanded by Lieutenant A. P. Niblack, of the navy, now went ashore, took possession of the enemy's intrenchments, and occupied the town. In these operations the Americans lost one man wounded; the loss of the Filipinos was probably slight. The enemy attempted to fire the town before abandoning it, but by the prompt action of Niblack this was prevented. The American, British and German consulates and the Filipino and Chinese quarters, however, were burned. After holding the city for an hour, Niblack turned it over to General Miller.[28]

On February 20 Commander Cornwell, having received orders from Wildes to take possession of Cebú, the capital of the island of the same name, sailed from Iloilo, with the *Petrel*, for that town. Reaching his destination on the following day, he sent word to the local authorities that he would be glad to consult with them respecting the occupation of Cebú. A few hours later a committee came on board the *Petrel*, and Cornwell read to it the proclamation of President McKinley setting forth the beneficent objects of the American government in behalf of the Philippines, and urged it to consider the uselessness of offering resistance and the saving of life and property that would be effected by a peaceful surrender. On the 22d the authorities sent a representative to the *Petrel* to say that they would make no resistance, but that they

[28] U. S. Navy Department, Bureau of Navigation, Files 166819.

wished to register a protest against the action of the Americans. A landing party, under the command of Lieutenant J. H. Bull, now went ashore and hoisted the American flag, which was saluted by the *Petrel* with twenty-one guns. On the return of the party, Cornwell, accompanied by Bull and two orderlies, landed and met Señor Flores, the governor and commander-in-chief of the island, at the governor's house. He now assumed charge of the government; and he informed the governor that he would be glad to have his assistance, that he would retain in office such officials as desired to remain, and that he would guarantee as far as possible individual liberty to the citizens and the protection of their property. He appointed a collector of customs and a captain of the port, and caused the American flag to be hoisted on the government house, where he established his headquarters. He retained possession of the town until relieved of his duties by an officer of the army.[88]

In addition to the occupation of Iloilo and Cebú, several other naval operations took place in 1899 in this part of the archipelago. In October the *Concord* bombarded the town of Tigbanan, in Iloilo Straits, and prevented the enemy from crossing between Panay and Negros. Assisted by several other vessels, she also bombarded the town of Bonati and compelled the enemy to abandon it. In November the *Concord* shelled a town on Carabao Island. In December the *Concord*, *Paragua* and *El Cano* captured the town of Romblon, situated on an island of the same name north of Panay.

Several vessels in 1899 operated to the southward of Panay and Cebú. In March the *Boston* reconnoitered Zamboanga and the Sulu Islands, and a few weeks later the *Concord* and *Petrel* convoyed some Spanish gunboats from Zamboanga to Manila. From June to December the *Castine* cruised in the Sulu Islands with a view to the prevention of uprisings among the natives and to coöperation with the army. On November 16 the *Castine* and *Manila*, aided by some friendly natives and Moros, captured the town of Zamboanga, and two days later Commander S. W. Very, of the *Castine*, received the surrender of the province of Zamboanga.

The record of prizes taken by our vessels in the insurrection is very incomplete. Among the captures in 1899 were the two

[88] U. S. Navy Department, Bureau of Navigation, Files 166819.

Filipino steamers *Taaleno* and *Mundaca*. The Americans that year lost the gunboat *Urdaneta*, Naval Cadet W. C. Wood, which was destroyed by the insurgents at Orani, Luzon. The *Charleston* was wrecked on a coral reef off Kamiguin Island, all her officers and men being saved. In April the insurgents captured at Baler, Luzon, Lieutenant J. C. Gilmore and fourteen men.

The operations of the navy in the Philippines during 1900 were of the same general character as those of the previous year. The duties of the smaller vessels in preventing illicit trade, however, seem to have been even more exacting than formerly. The principal fields of naval activity had now shifted to the neighborhood of Olongapo, to Southern Luzon, and to the islands of Samar and Leyte. Only the more important operations of the navy for this year will be here mentioned.

In January Commander H. Knox, in the *Princeton*, took possession of the Bantan group of islands, and in April Commander E. H. Gheen, in the *Marietta* captured Baler, Luzon. In February, March, and April parties of marines made several expeditions and captured or destroyed several towns near Olongapo. In a skirmish with the enemy on February 16, the marines had two men killed. In the same month a party under Lieutenant J. H. Gibbons rescued and recaptured in Southern Luzon ten Americans, four hundred and sixty Spanish officers and soldiers, and several priests, merchants and Filipinos. In May the *Pampanga* landed a force of men and captured a town in the island of Leyte. In the summer the most important movements of the navy were in Samar, Panay, and Mindanao, where the enemy's entrenchments were frequently shelled. During 1900 more than sixty-five small vessels, chiefly bancas and proas, were taken by the American ships.

From January, 1901, until April 1, 1902, when the insurrection in the Philippines came to an end, more than twenty-five engagements or hostile movements took place in which the navy participated. The principal fields of its activity were southern Luzon and Samar. In January, 1901, one of the boats of the *Don Juan de Austria* captured twelve prisoners near Donsol, southern Luzon. In March the *Vicksburg* coöperated with the army in the capture of General Aguinaldo. From November, 1901, to March, 1902, parties of marines had frequent engagements in Samar, which resulted in considerable loss to the enemy.

Among the vessels that made detailed reports of naval operations, is the *Don Juan de Austria*, Commander T. C. McLean. In January, 1901, she was cruising off southern Luzon and the adjacent islands. A brief extract from the report of her commander will serve to give some notion of the work performed by the vessels on the blockade during the insurrection:

Jan. 21. Proceeded from Boco Engaño, Burias Island to Donsol, Luzon, with 47 bags of rice seized by the *Arayat*. Turned the rice over to army for storage at Donsol.

Jan. 22. Left Donsol in early morning: patrolled the east coast of Burias, stopped at Claveria and anchored at San Pascual, Port Busin.

Jan. 23-24. Examining town, and vicinity of San Pascual and adjacent waters and obtaining various information. A list of boats and owners belonging to San Pascual is enclosed herewith.

Jan. 25. Left Port Busin. Patrolled coast of Burias, overhauling native boats. Off Claveria overhauled the *Parao Gonsalito*, returning to San Pascual with license just obtained at Donsol. Interrogation of master of *Parao* resulted in his confirming, unintentionally, my suspicions in regard to the real conditions at Claveria and San Pascual. Ostensibly, because of his having two bags of rice on board and because of his improbable statements in regard to having paid money in addition to fines, at Donsol, the master of the *Parao* was held on board this ship for further examination, which proved to be of great service. The *Parao* and crew were allowed to proceed to San Pascual.

In the evening brought the ship to anchor off Donsol. In the night sent the steam launch in charge of Cadet Allen Buchanan, U. S. N., with armed boat's crew in an expedition to Pillar with an army officer, seven soldiers, and three native guides. The object of this expedition was the capture of an insurgent captain. The expedition was very well managed by the army officer, Lieut. Cole, U. S. V., and failed only because the insurgent captain had gone to Cariguran that day. . .

Jan. 28. About three o'clock in the morning sent the troops, the scouts, and an armed party of sailors ashore in the steam launch, two cutters and a whale boat. Steam launch and 1st cutter mounting Colt automatic guns, boats' crews armed with rifles. Ensign John Halligan, U. S. N., in charge of boats and landing party of sailors. Asst. Surgeon J. A. Murphy, U. S. N., was the medical officer of the landing party, troops and sailors. The object of this expedition was to capture General Ramon F. Santos who was in charge of the district, and receiving supplies of rice, money, etc., brought off by boats to Maringondon. Santos escaped, but his adjutant was captured. The adjutant had a paper signed by Santos, giving him a short leave of absence. In the skirmish actions an insurgent officer, mounted, was killed, also several others, and some were wounded. No casualties on our side.[24]

The anti-foreign movement in China that culminated in the boxer uprising of 1900 caused serious disturbances as early as

[24] U. S. Navy Department, Bureau of Navigation, Files 262508.

1898.[88] In the fall of that year several foreign governments responded to the call of their ministers at Peking for protection. The government at Washington sent Lieutenant Dutton and eighteen marines to Peking to act as a guard to the American legation there. After the excitement quieted down, the marines were withdrawn.

Early in 1900 the demonstrations against foreigners were renewed, and the Navy Department found it expedient to augment its force in Chinese waters. In May the foreign ministers again appealed for protection and several occidental governments at once responded. A company of American marines, fifty-six in number, under the command of Captain B. H. McCalla, of the navy, was dispatched from Taku to Peking. This company was the first of the foreign detachments to enter the city. Its commander, McCalla, shortly returned to Tientsin, leaving the men under the command of Captain J. T. Myers.

Early in June the situation at Peking became still more critical, communication with Tientsin was cut off, and the legations were threatened with attack. The various foreign governments maintaining diplomatic representatives in China prepared to send forward a relief expedition. Soon McCalla had a detachment of marines numbering one hundred twelve men ready to join the allied forces. On June 10 an international army composed of British, Americans, Japanese, Italians, and Austrians left Tientsin for the capital, and it was shortly joined by detachments of Germans, French, and Russians. The entire force numbered two thousand and sixty-six officers and men, and was commanded by a British vice-admiral, Sir Edward Seymour. The expedition met with considerable opposition, and at the end of ten days it was still forty miles from the capital, having reached Lang-fang. Here, finding the railway useless, possessing insufficient means for an extensive campaign, encumbered by more than two hundred wounded men, and entirely cut off from communication both in the front and rear, it decided to fall back to Tientsin. It retreated as far as the imperial arsenal, situated a few miles from that city, which it captured, and there halted and awaited reinforce-

[88] For the operations of the navy in the Boxer uprising, see R. W. Neeser's Statistical and Chronological History of the United States Navy, vol. ii, 276-279, and the references there given; Mrs S. P. Conger's Letters from China, 24-29, 90-159; and R. S. Collum's History of the U. S. Marine Corps, 410-427.

ments. In this expedition, the Americans displayed great gallantry, losing four men killed and twenty-eight wounded, among the latter being McCalla, who was wounded three times.

During the advance and retreat of Seymour's expedition, the situation at Tientsin had become critical. The foreign settlement was threatened, and the communication between the city and Taku was interrupted. It was necessary for the allies to obtain possession of Tientsin and its environs before again attempting the relief of Peking. On June 22 one hundred thirty American marines, under Major L. W. T. Waller and a Russian force more than three times as large made an unsuccessful effort to relieve the foreigners at Tientsin, and were surrounded and almost overpowered. The marines lost four men killed and seven wounded. Two days later the allies, two thousand strong fought their way to the foreign settlement outside the walled city, and on the following day relieved Seymour and McCalla at the imperial arsenal.

The allies next turned their attention to the walled city, which was occupied by Chinese troops. On July 9 they assaulted the right flank of the enemy, losing forty-five men and inflicting a loss of about five hundred. Four days later they made a general attack, blew in the south gate of the city, and entered and took possession of Tientsin. In the first attack the Americans were represented by Waller and his marines, and in the second by three hundred forty-eight marines under the command of Colonel R. L. Meade and two battalions of infantry under the command of Colonel E. H. Liscum. The latter officer and Captain A. R. Davis of the marine corps were killed. On the death of Liscum, Meade succeeded to the command of the Americans. Both officers and men fought with great bravery in these actions. The loss of the marines was twelve killed and fifty-seven wounded.

Communication with the legations had now been cut off for several weeks, and the belief had become general that the ministers and other foreigners in Peking had been killed. Under these circumstances, the allies planned to collect an army of eighty thousand troops before marching upon Peking. The American government contemplated sending some eighteen thousand men to China, and it selected General Adna R. Chaffee to command them. While the allied forces were being concentrated at Taku and Tientsin, information was received from the American min-

ister, Mr. E. H. Conger, that the foreign population at Peking was still alive and that only quick action would prevent a general massacre. On the receipt of this news a relief expedition, consisting of nineteen thousand American, British, Japanese, Russian, and French troops, was organized. It left Tientsin on August 4, and ten days later arrived at Peking and relieved the imprisoned foreigners. The American marines in this expedition numbered about five hundred, and were commanded by Major W. P. Biddle. Their loss was about ten men.

Relief to the legations came none too soon. From June 19 to July 14 they were attacked almost daily, and from the latter date until relieved they withstood several severe attacks. The detachment of American marines under Myers occupied a strategic position of great importance on the city wall, where it established a sand-bag fort. Although repeatedly attacked by greatly superior numbers, and on two occasions temporarily driven from the wall, it was never permanently dislodged, and was still holding this vital position when relief came. On July 3 it made a brilliant sortie against the enemy and captured several guns and standards. Its loss during the siege was seven killed and fourteen wounded, almost forty per cent. Its commander, Myers, was wounded.

After the suppression of the insurrection in the Philippines and of the boxer uprising in China, the navy settled down to the performance of routine duties. In the Philippines, however, sporadic movements of the insurgents at times engaged its attention. In 1903 it was still patrolling the coast of Mindanao and the Sulu Islands and was aiding the army in suppressing illicit trading. In March, 1906, a naval detachment in coöperation with the army captured several of the enemy's cottas by assault at Mount Dajo, Jolo Island. In the fall of 1908 the battleship squadron in its cruise around the world visited the Philippines and the Far East and was received with most lavish hospitality.

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A SHORT METHOD OF CALCULATING THE ZENITH DISTANCE.

By H. B. GOODWIN.

It is a leading characteristic of the St. Hilaire method of laying off position lines by means of "calculated altitudes," which is now coming into very general use, that it readily lends itself to the employment of tabular methods, whereby logarithmic calculation is either altogether dispensed with or very greatly simplified, as the case may be.

Such a method, devised by Lieut. Radler de Aquino, of the Brazilian Navy, was described at length in the PROCEEDINGS not long since. In the year 1910 Admiral Garcia Mansilla, of the Argentine Navy, published a volume of tables with the same object in view, and more recently Captain Guyou, of the French Navy, has brought out a compendious work of the same nature.

In each case the method followed presents novel and ingenious features of its own, but probably the most simple and easily intelligible work of the kind is that produced by Mr. F. Ball, a naval instructor in the British Navy. In this comprehensive work Mr. Ball gives the altitude corresponding to each complete degree of latitude and of hour angle between the values of 0° and 60° both of latitude and declination, the argument declination proceeding also by single degrees. And since in working by the St. Hilaire process the computer can take as his point of departure any position not far removed in latitude and longitude from the dead reckoning values, it is easy by a simple process of adjustment to obtain a point such that latitude and hour angle may each be represented by a complete degree. No interpolation is, therefore, required, except for the odd minutes of declination, which again is simplified by the use of a table specially designed for the purpose.

It happens, however, that a set of tables planned upon such an elaborate design as this is necessarily somewhat bulky, and that

the consequent expense of production places it beyond the reach of mariners in general, and it has occurred to the writer that there might perhaps be room for a volume of tables, which, proceeding generally upon the lines followed by Mr. Ball, would be of smaller dimensions, and consequently be more generally accessible to seamen.

The general idea upon which the proposed table would be based is this: In the triangle of position PXZ, P is the pole, Z the zenith and X the place of the body observed. Let us suppose that c, the colatitude, and h, the hour angle, are regarded as constant, and that z is the zenith distance corresponding to a given value of p, the polar distance. Let p be increased by a certain amount (Δp), and let z_1 be the zenith distance corresponding to the new value of the polar distance for the constant values c and h.

Then by Taylor's theorem,

$$z_1 - z = \frac{dz}{dp}(\Delta p) + \tfrac{1}{2}\frac{d^2z}{dp^2}\sin 1'(\Delta p)^2 + \tfrac{1}{6}\frac{d^3z}{dp^3}(\sin^2 1')(\Delta p)^3 + \ldots.$$

Let us suppose that z has been calculated and tabulated for given values of p, c, h, and, for the present leaving out of consideration the third term of the expansion, let $\frac{dz}{dp}(\Delta p)$ be denoted by Correction A, and let $\frac{1}{2}\frac{d^2z}{dp^2}\sin 1'(\Delta p)^2$ be indicated by Correction B.

Then

$$z_1 = z + A + B.$$

We will assume, then, that $\frac{dz}{dp}$, $\frac{1}{2}\frac{d^2z}{dp^2}\sin 1'$ have been calculated. It will be convenient to give the results in the form of logarithms.

Thus

$$\log A = \log\frac{dz}{dp} + \log(\Delta p),$$

$$\log B = \log\tfrac{1}{2}\frac{d^2z}{dp^2}\sin 1' + 2\log(\Delta p),$$

the logarithms of $\frac{dz}{dp}$ and of $\frac{1}{2}\frac{d^2z}{dp^2}\sin 1'$ being taken from the proposed table, and that of (Δp) from the ordinary table of logarithms of numbers.

Taking into account only these two terms of the series it will be sufficient to tabulate for each 8° of declination, so that by

including only 0°, 8°, 16°, 24° North and South, we should cover the whole range of declination from 28° N. to 28° S., thus effecting a very great saving in the size of the volume of tables necessary at the expense of a very little additional trouble in calculation.

It will first be necessary to obtain expressions for $\frac{dz}{dp}$ and $\frac{d^2z}{dp^2}$.

TO FIND AN EXPRESSION FOR $\frac{dz}{dp}$.

From the triangle PXZ we have

$$\cos h \sin c \sin p = \cos z - \cos p \cos c.$$

Differentiating,

$$\cos h \sin c \cos p = -\sin z \frac{dz}{dp} + \sin p \cos c,$$

$$\therefore \sin z \frac{dz}{dp} = \cos c \sin p - \sin c \cos p \cos h,$$

$$= \cos c \sin p - \sin c \cos p \frac{\cos z - \cos p \cos c}{\sin p \sin c},$$

$$= \frac{\cos c \sin^2 p + \cos c \cos^2 p - \cos p \cos z}{\sin p},$$

$$\therefore \frac{dz}{dp} = \frac{\cos c - \cos p \cos z}{\sin p \sin z} = \cos PXZ.$$

TO FIND AN EXPRESSION FOR $\frac{d^2z}{dp^2}$.

Since $\frac{dz}{dp} = \cos X$,

$$\frac{d^2z}{dp^2} = -\sin X \frac{dX}{dp}.$$

We have, therefore, to find an expression for $\frac{dX}{dp}$.

In the triangle PXZ the formula connecting X, p, h, c is

$$\cot c \sin p = \cot X \sin h + \cos h \cos p.$$

Differentiating,

$$\cot c \cos p = -\operatorname{cosec}^2 X \frac{dX}{dp} \sin h - \cos h \sin p,$$

$$\therefore \frac{dX}{dp} = -\sin^2 X \operatorname{cosec} h (\cot c \cos p + \cos h \sin p),$$

$$= -\sin^2 X \left(\frac{\cot c \cos p}{\sin h} + \cot h \sin p \right).$$

Substituting this value in the formula above,

$$\frac{d^2z}{dp^2} = \sin^2 X \frac{\cot c \cos p}{\sin h} + \cot h \sin p)$$

and

$$\log \text{ for Cor } B = \log \frac{d^2z}{dp^2} + \log(\tfrac{1}{2} \sin 1').$$

With regard to the algebraic signs of A and B, Correction A is *additive* for actual polar distance *greater* than tabular, *subtractive* for polar distance *less*, so long as the angle X lies in the first quadrant.

The rule is reversed when X is greater than 90°, and the cosine, therefore, becomes negative. This can only occur in the exceptional case when latitude of place is of same name as the declination, and smaller in amount. Correction B will be always *additive*.

THE METHOD OF TABULATION.

The arguments of the table will be three in number, viz., declination; proceeding by differences of 8° from 0° to 24°; the latitude, by single degrees from 0° to 60°; the hour angle, by differences of single degrees, *i. e.*, of 4 minutes of time.

The quantities tabulated would also be three in number, viz., the zenith distance, corresponding to the tabulated values of declination, latitude and hour angle.

The logarithm for Correction A, which, as has been shown, is simply $L \cos X$.

The logarithm for Correction B, obtained from the expression given above.

THE ADJUSTMENT OF THE DEAD RECKONING POSITION.

It is a feature common to tables of this nature that the point worked from upon the chart, that is, the point of origin for the intercepts, should be such that its latitude is an even degree. The longitude of the point also must be such as to give for the hour angle an even degree, or 4 minutes of time.

In the case of the latitude, no difficulty occurs, and it is only necessary to select the degree nearest to the D. R. latitude. To find the longitude the following artifice is adopted:

Find the hour angle of the body at Greenwich, *i. e.*, in the case of the sun the Greenwich apparent time, and express this hour angle in arc.

To this apply such an amount of arc, adding if the longitude is east, subtracting if it is west, as will make the hour angle resulting an exact degree, the amount of arc so applied being as near as possible to the D. R. longitude.

The arc thus applied will be the longitude of the position from which to work.

The following example will serve to illustrate the procedure:

In D. R. position lat. 28° 47′ N. longitude 27° 3′ W., when Greenwich apparent time was $3^h\ 47^m\ 32^s$, an altitude of the sun was observed. Find the latitude and longitude from which to work. The latitude is 29° N. For the longitude,

Greenwich apparent time (in arc)....	56° 53′
Subtract	26° 53′
Hour angle	30° 00′

Thus 26° 53′ W., differing from the D. R. longitude by 10′, gives the exact value of 2^h for the hour angle.

DESCRIPTION OF TABLES I AND II.

To illustrate practically the method proposed, two specimen tables are appended. For each table the hour angle 2^h is adopted. Table I gives the values of the zenith distances and of the angle PXZ for declinations 0°, 8° and 12° of same name as latitude, and for each degree of latitude from 0° to 30°. It has not been thought necessary to proceed to higher latitudes than 30° because the higher the latitude the more exact are the results furnished by the method. The latitudes 0° to 30°, therefore, supply a sufficient test.

In Table II are given the logarithms for the calculation of corrections A, B and C for the three values of the declination, except that in the case of declination 8° the logarithm for C is omitted, since this value of the declination would only be included in the tables under the system where Correction C is left out of account, the computation being effected by the use of Corrections A and B only.

It should also be mentioned that although, for greater clearness of exposition, the value of the angle X is shown in Table I, this actual value is not really necessary, the value of $L \cos X$, given in Table II as the "Log for Cor A" being all that is required. By adding the column of zenith distances to Table II,

therefore, we should be able to dispense with Table I and give all the necessary details in a single table.

PRACTICAL RULES FOR THE USE OF TABLES I AND II.

To obtain a required zenith distance by means of the tables we should proceed as follows:

FOR CORRECTION A.

Find the difference, expressed in minutes, between the polar distance of body, measured from the elevated pole, and the nearest tabular value.

TABLE I.

ZENITH DISTANCES AND VALUES OF THE ANGLE *X*.
Hour Angle 2^h.

Latitude.	Declination 0°.		Declination 8° (same name).		Declination 12° (same name).	
	Zen. Dist.	Angle *X*.	Zen. Dist.	Angle *X*.	Zen. Dist.	Angle *X*.
0°	30° 0′	90° 0′	30° 57′	103° 33′	32° 6′	109° 49′
1	30 1	88 0	30 41.5	101 40	31 43.5	108 3
2	30 4	86 0	30 28	99 45	31 22	106 16
3	30 8	84 1	30 16	97 49	31 2	104 27
4	30 14.5	82 2	30 5.5	95 51	30 44	102 35
5	30 22.5	80 4	29 57	93 53	30 27.5	100 41
6	30 32.5	78 7	29 50	91 53	30 12.5	98 46
7	30 44	76 12	29 45	89 53	29 59.5	96 49
8	30 57	74 18	29 42	87 52	29 48	94 51
9	31 12	72 25	29 41	85 51	29 38	92 53
10	31 28.5	70 34	29 41	83 49	29 30	90 51
11	31 46.5	68 45	29 44	81 48	29 24	88 50
12	32 6	66 58	29 48	79 48	29 20	86 49
13	32 27	65 13	29 54	77 48	29 17.5	84 46
14	32 50	63 30	30 1.5	75 49	29 17	82 43
15	33 13.5	61 49	30 11	73 50	29 18	80 41
16	33 39	60 10	30 22.5	71 54	29 21.5	78 39
17	34 5	58 33	30 35.5	69 59	29 26.5	76 37
18	34 33	56 59	30 50	68 5	29 33.5	74 36
19	35 2	55 27	31 6.5	66 13	29 42	72 36
20	35 32	53 57	31 24.5	64 22	29 52.5	70 37
21	36 3	52 29	31 44	62 33	30 4.5	68 39
22	36 35	51 4	32 5	60 46	30 18.5	66 43
23	37 8	49 40	32 24.5	59 3	30 34.5	64 49
24	37 42	48 19	32 51	57 21	30 51.5	62 57
25	38 17.5	47 0	33 16.5	55 41	31 10.5	61 7
26	38 53.5	45 43	33 43	54 4	31 30.5	59 18
27	39 30	44 28	34 11	52 28	31 53	57 32
28	40 75	43 14	34 39.5	50 56	32 16	55 48
29	40 45.5	42 3	35 10	49 25	32 41	54 6
30	41 24.5	40 54	35 41	47 56	33 7	52 27

TABLE II.

LOGARITHMS FOR CALCULATION OF CORRECTIONS.

Hour Angle 2h.

Latitude.	Declination 0°.			Declination 8° (same name).		Declination 12° (same name).		
	Log for Cor *A*.	Log for Cor *B*.	Log for Cor *C*.	Log for Cor *A*.	Log for Cor *B*.	Log for Cor *A*.	Log for Cor *B*.	Log for Cor *C*.
0°	.....	6.4013	.....	9.36976	6.3000	9.53021	6.3121	2.562
1	8.5428	6.3974	.....	9.30582	6.3200	9.49115	6.3220	.....
2	8.8436	6.3935	1.989	9.22878	6.3400	9.44733	6.3320	2.492
3	9.01803	6.3895	.....	9.13355	6.3600	9.39713	6.3420	.....
4	9.14175	6.3835	2.275	9.00828	6.3800	9.33818	6.3521	2.422
5	9.23679	6.3779	.....	8.8307	6.3895	9.26806	6.3619	.....
6	9.31370	6.3703	2.266	8.5167	6.3990	9.18302	6.3718	2.316
7	9.37755	6.3589	.....	7.3088	6.3990	9.07442	6.3807	.....
8	9.43233	6.3475	2.519	8.5708	6.3990	8.9271	6.3897	2.079
9	9.48014	6.3362	.....	8.8595	6.3990	8.7016	6.3989	.....
10	9.52207	6.3249	2.575	9.03226	6.3990	8.1713	6.4081	1.333
11	9.55923	6.3073	.....	9.15421	6.3918	8.3088	6.4070	.....
12	9.59247	6.2897	2.605	9.24818	6.3846	8.7445	6.4060	1.912
13	9.62241	6.2720	.....	9.32495	6.3774	8.96005	6.4043	.....
14	9.64953	6.2544	2.617	9.38921	6.3702	9.10304	6.4027	2.271
15	9.67421	6.2344	.....	9.44472	6.3590	9.20922	6.3971	.....
16	9.69677	6.2143	2.613	9.49231	6.3478	9.29403	6.3916	2.446
17	9.71747	6.1918	.....	9.53440	6.3325	9.36449	6.3815	.....
18	9.73630	6.1693	2.598	9.57201	6.3173	9.42416	6.3715	2.555
19	9.75368	6.1468	.....	9.60561	6.3021	9.47573	6.3615	.....
20	9.76974	6.1243	2.572	9.63610	6.2869	9.52099	6.3515	2.621
21	9.78461	6.0982	.....	9.66368	6.2654	9.56118	6.3344	.....
22	9.79825	6.0721	2.539	9.68875	6.2439	9.59690	6.3173	2.645
23	9.81106	6.0460	.....	9.71121	6.2225	9.62892	6.3002	.....
24	9.82283	6.0198	2.497	9.73200	6.2011	9.65779	6.2832	2.669
25	9.83378	5.9924	.....	9.75110	6.1771	9.68397	6.2577	.....
26	9.84398	5.9651	2.451	9.76852	6.1532	9.70803	6.2322	2.678
27	9.85349	5.9359	.....	9.78478	6.1269	9.72982	6.2133	.....
28	9.86247	5.9067	2.401	9.79950	6.1006	9.74980	6.1945	2.668
29	9.87073	5.8781	.....	9.81328	6.0742	9.76817	6.1706	.....
30	9.87844	5.8495	2.347	9.82593	6.0478	9.78494	6.1467	2.635
	Add for P. D. *greater* than Tabular. *Subtract* for P. D. *Less.*	Always *Additive.*	*Subtract* from *A.*	*Subtract* for P. D. *greater* than Tabular. *Add* for P. D. *Less.* — *Add* for P. D. *greater* than Tabular. *Subtract* for P. D. *Less.*	Always *Additive.*	*Subtract* for P. D. *greater* than Tabular. *Add* for P. D. *Less.* — *Add* for P. D. *greater* than Tabular. *Subtract* for P. D. *Less.*	Always *Additive.*	*Subtract* from *A.*

To the log of this difference add the "Log for Cor *A*" taken from the table.

The sum, rejecting 10, is the logarithm of Correction *A*.

FOR CORRECTION B.

To twice the logarithm of the difference between actual and tabular polar distance add the "Log for Cor *B*" from Table II.

The sum, rejecting 10, is the logarithm of Correction *B*. Apply Corrections *A*, *B* to the zenith distance tabulated in Table I, in accordance with the precepts at the foot of the respective tables.

EXAMPLES IN USE OF TABLES.

Example 1.—Find the sun's zenith distance for hour angle 2^h, in latitude 3° N., when the declination is 4° 6′ N. Here 8° is the nearest tabular value for the declination, the difference of polar distance (Δp) being 3° 54′, or 234′. Actual polar distance greater than tabular.

A		*B*	
Log for *A* (from Table II)	9.13355	Log for *B* (from Table II)	6.3600
Log 234	2.36922	2 Log 234.....	4.7384
(Sum)	1.50277	(Sum).....	1.0984
Cor *A*.....	31.8′−	Cor *B*.....	12.5′+
Cor *B*.....	12.5′+	Zenith distance (from Table I).....30° 16′	
	19.3′−	Corrections	19.3′−
		Zenith distance required .....29° 56.7′	

Here Correction *A* is subtractive for actual P. D. greater, because the "Log for *A*" is above the "bar," which, in Table II, for declination 8°, is drawn between the logarithms for 6° and 7° of latitude. This bar indicates the point at which the angle *X* passes from one quadrant to another, so that the cosine of the angle changes its sign, and the algebraic sign of the correction is altered accordingly. Reference to Table I shows that for latitude 6° the value of *X* is 91° 53′, and for latitude 7° it is 89° 53′.

Example 2.—Find the zenith distance of Procyon (Dec. 5° 27′ N.) for H. A. 2^h in latitude 25° N.

The nearest tabular value is again 8°, and the difference of polar distance 2° 33′ or 153′. Actual polar distance greater.

A		*B*	
Log from Table II..	9.75110	Log from Table II..	6.1771
Log 153.....	2.18469	2 Log 153.....	4.3693
(Sum)	1.93579	(Sum)	.5464
Cor *A*.....	86.2′+	Cor *B*.....	3.5′+
Cor *B*.....	3.5′+	Zenith distance (from Table I)	33° 16.5′
	89.7′+	Corrections	1° 29.7′+
		Zenith distance	34° 46.2′

Here actual polar distance greater gives an additive Correction *A*, because latitude 25° is below the bar, and *X* consequently less than 90°.

THE THIRD CORRECTION *C*.

We have so far considered only two terms of the series for *z*, the tabulation of which would enable us to employ a difference of declination of 8°, the values tabulated being 0°, 8°, 16°, 24° north and south, seven values in all. But if we include another term of the series, and thus obtain the logarithm for a third Correction *C*, it would suffice to proceed by a common difference of 12° of declination, as 0°, 12°, 24°, and the total number of values for the declination employed would thus be reduced from seven to five, with a considerable saving in the space occupied.

The next term of the expansion would be

$$\tfrac{1}{6}\frac{d^3z}{dp^3}\sin^2 1'(\Delta p)^3,$$

so that if the values of $\tfrac{1}{6}\frac{d^3z}{dp^3}\sin^2 1'$ are calculated and tabulated we have only to add three times the logarithm of (Δp) to the tabular logarithm to obtain the logarithm of *C*. As three places of decimals are amply sufficient, this is not a very troublesome operation.

TO INVESTIGATE AN EXPRESSION FOR $\frac{d^3z}{dp^3}$.

It has already been shown that

$$\frac{d^2z}{dp^2} = \sin^3 X\left(\frac{\cot c\cos p}{\sin h} + \cot h \sin p\right),$$

and also that

$$\frac{dX}{dp} = -\sin^2 X\ \frac{\cot c\cos p}{\sin h} + \cot h \sin p\Big).$$

Differentiating the first of these expressions,

$$\frac{d^3z}{dp^3} = 3\sin^2 X\cos X\frac{dX}{dp}\left(\frac{\cot c\cos p}{\sin h}+\cot h\sin p\right)$$
$$+\sin^3 X\left(\cot h\cos p-\frac{\cot c\sin p}{\sin h}\right).$$

But

$$\cot h\cos p-\frac{\cot c\sin p}{\sin h} = -\cot X,$$

$$\therefore \sin^3 X\left(\cot h\cos p-\frac{\cot c\sin p}{\sin h}\right) = -\sin^2 X\cos X.$$

Thus

$$\frac{d^3z}{dp^3} = 3\sin^2 X\cos X\frac{dX}{dp}\left(\frac{\cot c\cos p}{\sin h}+\cot h\sin p\right)-\sin^2 X\cos X,$$

Substituting for $\frac{dX}{dp}$,

$$= -3\sin^4 X\cos X\left(\frac{\cot c\cos p}{\sin h}+\cot h\sin p\right)^2-\sin^2 X\cos X,$$

$$= -\sin^2 X\cos X\left\{3\sin^2 X\left(\frac{\cot c\cos p}{\sin h}+\cot h\sin p\right)^2+1\right\}.$$

The final expression to be tabulated, therefore, is

$$-\tfrac{1}{2}\sin^2 1'\sin^2 X\cos X\left\{3\sin^2 X\left(\frac{\cot c\cos p}{\sin h}+\cot h\sin p\right)^2+1\right\},$$

which has to be multiplied by $(\Delta p)^2$ to give the amount of the correction.

As the amount of Correction C is never very large it will be found to be sufficient to calculate for each 5° of latitude, and interpolate by ordinary proportion. It will suffice also to take three places of decimals only, and to tabulate for each second degree. Interpolation for intermediate degrees could easily be effected at sight.

The negative sign of the correction indicates that C will be of opposite sign to A. In practice, the simplest plan will be to regard C as a deduction to be made from the value of A, and proceed accordingly.

PRACTICAL RULES FOR FINDING CORRECTION C.

Write down the log for Correction C from Table II. Under this write three times $\log(\Delta p)$ in minutes.

The sum, less 10, is the logarithm of C.

EXAMPLES (CORRECTION *C* TAKEN INTO ACCOUNT).

Example 3.—Find the zenith distance of Procyon (Dec. 5° 27′ N.) for H. A. 2^h in latitude 25° N.

It will be noticed that this example has been already worked, taking as our starting point declination 8°, and making use of Corrections *A* and *B* only. It will be instructive to work it also with the aid of all three corrections, making use first of the tabular values for declination 0°, and again with those given under declination 12°.

WITH DECLINATION 0°.

The difference of polar distance (Δp) is 5° 27′ or 327′. Actual polar distance *less* than tabular.

A		*B*		*C*	
From Table II..	9.83378	From Table II.....	5.9924	From Table II.....	2.474
Log 327.....	2.51455	2 Log 327....	5.0291	3 Log 327..	7.544
(Sum).....	2.34833	(Sum).....	1.0215	(Sum).....	.018
A.....	223′−	*B*.....	10.5′+	*C*.....	1′+
C.....	1 +	Z. D. from Table I.....	38°17′		
A−*C*.....	222 −	Corrections...	3°31.5′		
B.....	10.5+				
Correction.....	211.5−	Z. D. required	34°45.5′		

WITH DECLINATION 12° N.

A		*B*		*C*	
From Table II..	9.68397	From Table II.....	6.2577	From Table II.....	2.674
Log 393.....	2.59439	2 Log 393....	5.1888	3 Log 393..	7.783
(Sum).....	2.27836	(Sum).....	1.4465	(Sum).....	.457
A.....	189.8′+	*B*.....	28′+	*C*.....	2.9′−
C.....	2.9−	Z. D. from Table I.....	31°10.5′		
A−*C*.....	186.9+	Correction....	3°34.9′+		
B.....	28. +				
Correction.....	214.9+	Z. D. required	34°45.4+		

Thus, proceeding by a wholly different route, we arrive at precisely the same result as before.

For a second example we take a case in the neighborhood of the "bar," which, in the column "Log Cor *A*," in Table II, forms the dividing line between values of *A* in the first and second quadrant.

Example 4.—Find the zenith distance of the sun for H. A. 2^h in latitude 10° N. when the declination is 18° N.

Difference of polar distance is 360′. Actual polar distance *less* than tabular.

A		*B*		*C*	
Log from Table II.....	8.17130	Log from Table II	6.4081	Log from Table II..	1.333
Log 360.....	2.55630	2 Log 360.....	5.1126	3 Log 360..	7.669
(Sum).....	.72760	(Sum)	1.5207	(Sum).....	9.002
A.....	5.3′+	*B*	33.2′+	*C*.....	.1′−
C.....	.1−	Z. D. from Table	29°30′		
A−*C*.....	5.2+	Correction.....	38.4′+		
B.....	33.2+	Z. D. required..	30°8.′4		
Correction.....	38.4+				

This case may be regarded as a somewhat special one because *A* and *C*, being on the point of vanishing and changing sign, *B*, which is not far from attaining a maximum value, becomes the most important element in determining the amount of the total correction.

It should be remembered that although provision is made in the tables for all three corrections, it is by no means necessary that the whole of these should be taken into account on every occasion. When actual declination, for instance, falls within 1°, or 60′, of the tabular value, both *B* and *C* might very generally be both omitted, especially in the higher latitudes, and *C* need not be included when actual is within 3° or 4° of the tabular value of declination. A moment's inspection of the value for the logarithms of the corrections given in the table should show whether these are worth taking into account. In the example just worked, for instance, although we were employing a difference of polar distance between actual and tabular of 360′, which is a limiting value, the small amount of the "Log for *C*," viz., 1.333, would indicate at once that the resulting value of Correction *B* could only be a small fraction of a minute, and might, therefore, be left out of account.

Roughly speaking, *C* might probably be safely neglected in two-thirds of the whole number of cases.

Some little simplification would result also from the inclusion in the tables of a special table of "Logarithms of Numbers," occupying only a few pages of space. Such a table might furnish at sight the logarithm of a number, the logarithm of its square and of its cube. Risk of errors in multiplication would thus be eliminated.

The form for such a table is exhibited below.

Number.	Log.	Log of Square	Log of Cube.
275	2.43933	4.8787	7.318
276	2.44091	4.8818	7.323
277	2.44248	4.8850	7.327
278	2.44405	4.8881	7.332
279	2.44560	4.8912	7.336
280	2.44716	4.8943	7.341

It will be noticed that in the examples worked our results come out in pairs, that the corrections once determined give us the total correction for an actual zenith distance greater as well as less than the tabular by a given number of minutes.

Example 5.—In latitude 27° N. from the tabular values for declination 0°, find the zenith distances at H. A. 2^h for declination 4° N. and 4° S. respectively.

	A		*B*
Log for Table II....	9.85349	Log from Table II...	5.9359
Log 240.....	2.38021	2 Log 240	4.7604
(Sum)	2.23370	(Sum).....	.6963
A	171.3′	*B*	5′+

A..... 171.3′	For 4° S. (actual polar distance greater).	
5′	Z. D. from Table I.....	39° 30′
A−*B*.. 166.3′	Correction (*A*+*B*)	2° 56.3′+
A+*B*.. 176.3′	(Sum) Z. D.....	42° 26.3′
	For 4° N. (actual polar distance less).	
	Z. D. from Table I.....	39° 30′
	Correction (*A*−*B*)	2° 46.3′
	(Difference) Z. D.....	36° 43.7′

The results show that for a given hour angle the increase of zenith distance produced by an increase of polar distance (Δp) will in general be greater than the decrease in zenith distance caused by a diminution (Δp) in polar distance. In the exceptional case, however, when latitude being less than declination and of same name, the angle *X* lies in the second quadrant, the contrary will be the case.

SOME SPECIAL CASES IN THE VALUES OF THE CORRECTIONS.

If the hour angle is 0°, the angle X is also 0°; Corrections B and C vanish, cos X becomes unity and the change of zenith distance is equal to (Δp), the change in polar distance.

Correction B also vanishes if the body is in the horizon, since in that case

$$\cot c \cos p + \cos h \sin p = 0.$$

If $X = 90°$, that is, if the body is at the position of "maximum azimuth," $\cos X = 0°$. In that case A and C must both vanish and the total correction depends upon B. This point has been already illustrated in the work of Example 4.

GENERAL OBSERVATIONS.

A few words may perhaps be added here as to the history of the system of Marcq Saint-Hilaire position-lines, in which this problem of calculating zenith distance plays such an important part. Originally proposed by the late Admiral Saint-Hilaire in the *Revue Maritime*, in July, 1875, the method attracted little attention at the time, or for some years afterwards. Eventually, however, it came to be practiced extensively in the French Navy, and within the last few years it has received official recognition in the British Navy also, to the exclusion of all other methods. Still more recently the advantage of having one simple method of procedure, available in all cases, has come to be recognized more generally, and the practice of the Saint-Hilaire system is to-day steadily gaining ground in the mercantile marine.

Under these circumstances the problem of calculating a zenith distance, which, in the old days, was required chiefly for use in the identification of a star, and which commonly received only a casual degree of attention, and, indeed, in some cases, was not noticed at all in standard works on navigation, has acquired a largely increased amount of importance, so that navigators are naturally not unwilling to consider any device which seems to offer a simplification of the problem.

With regard to the system proposed in these pages the following points may be noticed.

(*a*) The method of procedure, by means of corrections applied to a tabulated zenith distance, is in many ways analogous to the recognized process for deducing latitude from an altitude of the

pole-star, and, with many of the methods for reducing a zenith distance, taken upon a small bearing to the meridian.

(*b*) With the aid of such a table of logarithms of squares and cubes of numbers as has been suggested up to 360, with the logarithms of the numbers continued up to 1000, the whole of the calculations need not involve more than two openings of the tables.

(*c*) The rules for the application of the algebraic signs are of a very simple character, the only point requiring particular attention being the difference between the actual and tabular polar distance, in connection with the sign of Correction *A*, and this involves only a moment's consideration.

(*d*) The summation of only two logarithms at a time is substituted for the customary "long tot." Risk of error in the process of addition is thereby largely reduced.

In view of the growing popularity of the Marcq position-lines, navigators would seem to be standing at a "parting of the ways." They are gradually discarding the ancient methods of fixing position by the direct determination of a latitude or longitude in favor of a system which offers a single solution of the problem, available at all times, irrespective of special conditions of hour angle and azimuth, involving the simple calculation of a zenith distance in all cases alike. The processes offered by the standard text-books leave something to be desired, and amongst the multitude of new methods proposed the mariner will doubtless in due time make his selection and pick out that which is best suited to his needs. The wider, therefore, the field of choice the better.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

REPORT OF THE UNITED STATES JOINT ARMY AND NAVY POWDER BOARD IN CONNECTION WITH AN EDITORIAL IN LONDON *ENGINEERING* OF OCTOBER 6, 1911.

INTRODUCTORY.

Within the last few months a number of editorials have appeared in London *Engineering* criticising the nitro-cellulose powder used in the United States Army and Navy, and claiming great superiority for nitro-glycerine powders, and especially cordite.

One of these editorials, published in *Engineering* of October 6, 1911, was referred for consideration and comment to the United States Joint Army and Navy Powder Board.

The editorial in question is here reproduced, followed by the comments of the Powder Board.

"THE 'LIBERTÉ' DISASTER AND PROPELLENT POWDERS."

EDITORIAL, ENGINEERING, OCT. 6, 1911.

While it would be, to say the least, premature definitely to ascribe the disaster to the French battleship *Liberté* to the spontaneous combustion of the propellent powder on board, there is sufficient justification for some examination of the subject, in view, firstly, of the tendency of naval opinion in France in favour of this theory, and, secondly of the question which has been raised in this country owing to inadequate information, as to the immunity, or otherwise, of our own ships from similar catastrophe. As a court of inquiry is to be held into the case of the *Liberté* disaster, we shall refrain from attempting any investigation of the subject. But consideration can profitably be given to the main points of comparison between the two classes of propellent powder used in the respective navies in order to set at rest any misgivings which may exist in this country as to the likelihood of similar accidents in our own ships. This, too, can

be done without injuring the susceptibilities of our friends in the French service, with whom all sympathise. They themselves, in large numbers, are disposed to attribute the accident to the spontaneous combustion of the powder, as the events immediately preceding the actual principal explosion are reported from reliable sources to have resembled greatly those which occurred in the case of the *Jéna* explosion, which was officially ascribed to the spontaneous combustion of the propellent powder on board. Moreover, it is of much significance that an order has been raised withdrawing from service all the propellent powders of a certain age still in the French ships. If the reports as to the newspaper interview with Admiral Bellue, commanding the Second Squadron, are correct, it would also appear that that officer has no doubts whatever in his own mind that the accident was due to spontaneous decomposition of the propellent powder, in the same way as occurred on the *Jéna*.

In speaking of this powder, it will be noticed that we emphasize the word "propellant" and we do so advisedly, inasmuch as many writers in the daily journals confuse this class of powder with high explosives or shell powders used for destructive purposes. Briefly, a propellent powder is the powder used in the gun for projecting the shot therefrom. Being generally of a colloidal type, the speed of combustion is entirely under the control of the manufacturer, in that it burns from the surface only, and therefore can be manufactured to burn slowly or quickly according to the size of the gun for which it is intended. High explosives however, being designed for use in shells and to do the greatest amount of damage by disruption of the shells containing them, it is essential that their combustion should be as rapid as possible, and if they can be detonated, so much the better; detonation has been defined as "instantaneous decomposition throughout the mass." It is evident, therefore, that a propellent powder would be unsuitable for a shell, whilst a high explosive powder used for filling shells would shatter a gun to pieces if detonated therein. The modern types of high explosives, such as picric acid, trinitrotoluol, etc., are very stable bodies, so no fear need be entertained that they are to blame. Propellent powders, on the other hand, are far more complex, and susceptible to various influences and consequent changes in their characteristics and behavior, which constitute at all times

a certain element of anxiety. It is only by the utmost care in the choice of a propellant and in the manufacture thereof, combined with a most throrough system of periodical inspection, testing, and proper conditions of storage at moderate temperatures, that disasters similar to those which have, unfortunately, occurred elsewhere have been avoided in our Navy.

There is a broad distinction between the types of propellent powders used by Great Britain and France, the one being what is known as the nitro-glycerine type, the other the nitro-cellulose type. Besides Great Britain the following countries use the nitro-glycerine type for their navies: Germany, Italy, Japan, Brazil, Argentina, whilst those which use the nitro-cellulose type are France, the United States, and Russia. It is a somewhat striking fact that, with the exception of Russia, it is the navies that use a nitro-cellulose propellent powder which have had most trouble and accidents. Russia, however, has not had a very severe trial, as her ships mostly lie in cold climates, not being too often at sea, and consequently, with steam up, the magazines are seldom warmed to high temperatures, or, even if so, are not kept at high temperatures for long periods. In all navies magazine cooling has done a great deal towards minimizing risks with either class of powder; but magazine cooling alone is insufficient for safety unless accompanied by a proper system of inspection and testing.

A nitro-glycerine propellent powder consists of an intimate mixture of nitro-cotton and nitro-glycerine, to which is generally added a small percentage of non-volatile matter, the most usual being "mineral-jelly," popularly known as vaseline. The nitro-cotton, of which gun-cotton is a high grade, is mixed with the nitro-glycerine by hand in suitable proportions, generally about two or three parts of nitro-cotton to one of nitro-glycerine, and is then machine-mixed with acetone and mineral jelly, passed through suitable dyes, etc., and finally dried in hot-air stoves. The acetone breaks down the structure of the nitro-cotton, and is said to gelatinize it —*i. e.*, change it more or less into a colloid, and, as the nitro-glycerine and mineral jelly are already colloids, it follows that the resultant mass when squeezed into cords or tubes through suitable dyes, or rolled out into strips, is also colloidal; in other words, the physical state of the finished article is such that combustion takes place only on the surface instead of

penetrating the mass. The mineral jelly also has, so to say, a "water-proofing" effect which preserves the propellant against the deleterious influence of changes in atmospheric conditions, and prevents alterations in the percentage of the residual moisture which it is impossible completely to extract or dry out. This is a most important point, as will be shown presently.

A nitro-cellulose powder consists almost entirely of nitro-cellulose, another grade of nitro-cotton containing less nitrogen than the gun-cotton used in a nitro-glycerine powder. The solvent or gelatinizing agent employed with nitro-cellulose propellants is a mixture of ether and alcohol; acetone will not do, as it makes the finished article too brittle, and, further, would gelatinize it to too great an extent, rendering the powder difficult to burn. Consequently, as nitro-cellulose powders are not of such a colloidal nature as nitro-glycerine powders, and as it is impossible to incorporate mineral jelly with them, they are thus considerably influenced by differences of temperature, moisture, etc., necessitating their storage, in hermetically sealed cases. This is a necessity, from a ballistic point of view, for the reason that even very small fluctuations in the percentage of residual moisture have a very large influence upon the behavior of the powder in the gun, with consequent loss of accuracy in the shooting. On the other hand, hermetically to seal up a case of powder is distinctly deleterious in the long run to the chemical stability of that powder, more particularly in hot climates or in hot magazines; for if the gaseous products of decomposition are not allowed to escape, they have a cumulative effect upon the rest of the powder. It may be here remarked that all modern propellent smokeless powders of the nitro type, being, as it were, in a state of strain, commence a slow, though gradual, decomposition from the moment they are made; consequently, any influence which tends to hasten such decomposition, or which causes a cumulative effect in such decomposition, is to be carefully avoided. In addition, therefore, to keeping modern propellants cool, it is necessary that they should be aërated, and not bottled up in hermetically closed cases, otherwise a time will come when the decomposition will become so accentuated and rapid that the accumulation of the gaseous products of decomposition in the sealed cases will engender sufficient heat to burst into flame. Then, in an enclosed space, such as a ship's magazine, the gases

of the burning powder, not being able to escape sufficiently rapidly, will set up such a pressure as to reach the critical point, when the burning will change to explosion of a violent character and the ship will be destroyed.

In comparing the nitro-glycerine and nitro-cellulose types of propellent powders we have two entirely different sets of factors. With the nitro-glycerine type we have a powder which, from the nature of its composition, is more stable, which can be safely left in non-air-tight cases and allowed to aërate freely, and which is not so subject to the great influence of fluctuations in moisture content, and which, consequently, gives very even shooting results.

On the other hand, a nitro-cellulose powder is inherently less stable, is greatly influenced by fluctuations in percentage of moisture content, with consequent loss of accuracy in shooting, necessitating its enclosure in hermetically sealed cases, which not only prevent its aëration, but also render its systematic inspection and testing much more difficult. From the above considerations it is evident that, at any rate for naval purposes, a nitro-cellulose propellent powder cannot compare as regards stability with a nitro-glycerine propellent powder. The only point in its favor is the claim that it gives less erosion, but this has, in recent years, been found to be based on a wrong premise—viz., that the temperature of combustion of a nitro-cellulose powder being lower than that of a nitro-glycerine powder, the erosion with the former is less. Experiments have shown, however, that erosion is not only a function of the temperature of explosion, but also of other factors which tend to counter-balance the advantage of the lower explosion temperature.

It is somewhat surprising, therefore, to see the French Navy adhering to a powder which offers, apparently, no advantages, and indeed, would appear to be distinctly inferior, from every point of view, to a nitro-glycerine powder, if we are to judge from the experience of those navies which, presumably having tried both classes of powder, decided, for naval purposes, to adopt the nitro-glycerine type. It is interesting to note that Germany, Japan, Brazil, and Argentina, though using a nitro-cellulose powder for their armies, use, so far, only nitro-glycerine powder for their navies. Great Britain uses the latter for both Navy and Army. In any case, even with the more stable nitro-

glycerine powder, a rigid and thorough system of inspection and testing must be carried out, not only during manufacture and on proof, but also during subsequent storage and use in the service. It is satisfactory to know that in no country in the world is such scrupulous care taken in these respects as in this country. We make no apology for referring to two articles on the subject of "Nitro-cellulose Powder for Naval Purposes," which appeared in *Engineering* of August 19, 1911, and May 20, 1910. The latter, written a short time after the *Jéna* disaster, quotes from the "*Memorial des Poudres et Salpetres*," a French Government Publication, and also from official United States instructions, all of which fully bear out the arguments put forward above in support of our contention that for naval purposes a nitro-cellulose powder is unsuitable, and will possibly be found to be the cause of the terrible accident to the *Liberté*, which we, as a nation, deplore as deeply as our friends in France.

REPORT OF JOINT ARMY AND NAVY BOARD ON SMOKELESS POWDER.

WASHINGTON, D. C.

FROM: Joint Army and Navy Board on Smokeless Powder.
TO: Bureau of Ordnance, Navy Department.
SUBJECT: Editorial London *Engineering*, Oct. 6, 1911, "The *Liberté* Disaster and Propellent Powders."

In accordance with a request from the Chief of Bureau of Ordnance, U. S. Navy, this Board has given careful consideration to the editorial in London *Engineering* of Oct. 6, 1911, (copy prefixed hereto), in which a comparison is drawn between the nitro-glycerine powders used in the British and certain other navies, and the pure nitro-cellulose powders used in the navies of the United States, France and Russia.

NOTE.—For convenience, powders containing nitro-cellulose alone are commonly designated as "nitro-cellulose" powders, and those like cordite and ballistite which contain both nitro-cellulose and nitro-glycerine, by the convenient though inexact term, "nitro-glycerine" powders.

The fact must always be kept in mind, that the so-called "nitro-glycerine" powders contain nitro-cellulose as their principal ingredient; so that all evidence going to prove the instability of nitro-cellulose *as such*, applies with equal force to both types of powder unless it can be shown that the addition of nitro-glycerine has some stabilizing effect upon the nitro-cellulose.

The first point to be noted in the article under consideration is the assumption that all nitro-cellulose powders are of necessity identical, and that to designate the powder used in the United States or elsewhere as a "nitro-cellulose powder" is to describe it completely and to establish its identity with the powder which has given so much trouble in France. As a matter of fact, there are very important points of difference between our powder and that which is supposed to have caused the destruction of the *Jéna* and the *Liberté*.

To begin with, our methods of manufacture, stowage and test are incomparably superior to those which the French authorities themselves describe as having obtained in the French service, and the insufficiency of which might well be held to account completely for the accidents to the *Jéna* and the *Liberté*. Moreover, the standard powder of the United States Army and Navy has for several years past contained a "stabilizing" ingredient which is universally recognized as enormously improving the stability of powders containing it and which, while it is reported to have been recently adopted for French powders, was not contained in any of the powders which have given trouble. Thus it is entirely misleading to discuss our powder as if it were identical with the French powder which was involved in the *Jéna* and *Liberté* disasters.

That the imperfect methods used in France might well be considered as accounting for the accident to the *Jéna* was the view expressed by *Engineering* editorially in commenting upon the destruction of that vessel.

> . . . . it is quite clear that the disaster on board the *Jéna* was due to faulty location of the ammunition magazines and to imprudence generally. From this speech it is evident that the smokeless powders of any nation—and they are all practically the same composition—would have behaved in the same way in similar circumstances.—*Engineering*, October 30, 1908, page 579. Editorial, "Smokeless Powders."

As regards the matter of stabilizers, we start with the fact, now universally admitted, that all types of smokeless powder are subject to some degree of deterioration within the limits of temperature which prevail or may prevail in magazines on shipboard and elsewhere. The question arises, then, whether it is possible to prevent or delay the progress of this deterioration by incorporat-

ing in the powder some substance which shall act as a deterrent of decomposition, thus becoming a "stabilizer" for the powder.

It will be shown hereafter that the alcohol used as a solvent for pure nitro-cellulose powders is very helpful in this direction, especially when the powder is kept in air-tight containers; and that the mineral jelly used in cordite has a similar beneficial action. Within the rather limited scope of the action of these substances, the two types of powder seem to be on approximately an equal footing, if we disregard for the moment the claims made by *Engineering* in the matter of open *vs.* closed containers for stowage. Within the last few years, however, there has been introduced into our manufacture a substance known as di-phenylamine, the stabilizing power of which is several times as great as that of the mineral jelly upon which the English rely to protect their cordite or the alcohol upon which we formerly relied and upon which the French have relied until very recently. This substance has been used in German powders for many years, with complete satisfaction, and our own tests of its efficiency have been entirely convincing. It is believed that powders which in themselves would have a safe life of six or seven years can be confidently counted upon, if containing diphenylamine, for a life of twenty years, and perhaps much more than this.

It is evident that the adoption of this substance marks a new era in the manufacture of smokeless powders and that a sharp distinction must be drawn, in all discussions of stability, between those powders which do, and those which do not, contain diphenylamine; that is to say, so far as United States powders are concerned, between those made prior to 1908 and those made since that date. With regard to the former, there is good reason to believe that with the system of inspection in use, they are perfectly safe for a longer period of time than that for which they are trusted in practice, this period being much shorter than that which would be safe with the present powders. We believe it to be well established by the evidence which will be cited in the later pages of this report, that these earlier powders, made of pure nitro-cellulose and without diphenylamine, are superior in stability to nitro-glycerine powders which are also made without diphenylamine. In view, however, of the fact that a diphenylamine powder has been the standard of the United States Army and Navy for several years, no other powder having been manufactured

during that time, it is manifestly unfair at this date to speak of the earlier powder as if it were the present standard; and it is hardly to be supposed that even critics as prejudiced or as imperfectly informed about our earlier powder as we believe the writer in *Engineering* to be, would condemn our present powder as unsafe.

So far as navy powders are concerned, the policy is to retire the earlier powders as rapidly as is convenient, and replace them by the new type; not because the older powders are bad, but because, however good they may be, they are inferior to the newer ones.

The older powders are "re-worked," by a process which makes them new in every sense of the word, diphenylamine being incorporated in the course of the process. It is important to emphasize the fact that this reworking has nothing in common with the very superficial "radoubage" used by the French in an attempt to restore the stability of deteriorated powders. The French process consists in little beyond the adding of solvent to replace that which has evaporated. Our process begins with a complete physical disintegration of the colloid, by pulverizing, reducing it to finely divided nitro-cellulose, which is then started upon the same course of thorough purification to which the nitro-cellulose is subjected in original manufacture, no single step of boiling or washing being omitted. In fact, the only steps of the original manufacture which are omitted from the re-working are the nitration of the cotton and the steps preliminary to nitration. Diphenylamine is introduced exactly as in new manufacture, and the resulting product is, in the fullest sense of the term, a *new* powder; *not* an old powder modified.

The above description of our re-working process constitutes a reply to certain criticisms of what was assumed to be the process, which have appeared in *Engineering* since the article with which we have been chiefly dealing in the present paper. The later article, which appeared in the issue of *Engineering* of Nov. 3, 1911, starts with the assumption that our process of reworking is a mere attempt, like that of the French, to bolster up a bad powder, and with this assumption, *Engineering* proceeds to point out the error of this policy and to predict disaster as a result of it. This is reasonable enough as applied to "radoubage," but has no application whatever to our process.

While it will be seen from what precedes that the strictures of *Engineering*, in the article now under consideration, in so far as they apply to our present powder, are valueless because based upon entirely false assumptions as to the nature of the powder, we believe that these strictures could be successfully refuted on the broader ground that nitro-cellulose powders as such are inherently safer than nitro-glycerine powders—assuming both to have been made with equal care.

It will be interesting in this connection to note certain opinions heretofore expressed by *Engineering*, when it did not feel called upon to reassure an anxious public with regard to the safety of cordite; and when, also, the question of British *vs.* United States powder was not under consideration by South American powers having large contracts for war material to be placed either in England or in the United States.

On November 18, 1888, Sir Hiram Maxim took out Patent No. 16,213, for a smokeless powder made of pure tri-nitro-cellulose of the highest degree of nitration, and also apparatus for manufacturing the powder. This gun cotton was dissolved or softened in ether, alcohol and acetone, and then formed into grains of varying sizes, this composition being the identical powder which is now used in the United States of America and made in the same way. They have used it ever since they abandoned the nitro-glycerine compound. It is a very stable powder, and perhaps, everything considered, is the best possible class of smokeless powder.—*Engineering*, January 27, 1911, page 125. Editorial, "Naval Ordnance and Smokeless Powder."

All nitro powders being highly exothermic chemical compounds, in place of a mere mixture of reagents, such as common black powder, are much more liable to deterioration when stored under high temperature. The disastrous explosion on board the *Jéna* will be in the minds of all, and our own Navy and Army have also suffered from this unfortunate characteristic of the modern type of propellant, though fortunately, on a much less serious scale.—*Engineering*, June 14, 1907, page 780. Editorial, "The Cordite Debate."

In December 1899 a six-inch cartridge on the Revenge ignited spontaneously, and two other cartridges in the same box were also found to have gone off. In the autumn of last year, moreover, there were two spontaneous explosions at Cordite Magazines in India. The spontaneously ignited ammunition cannot be represented as the natural outcome of a contractor's "greed for dividends," but was actually manufactured at Waltham Abbey under the supervision of officials as to whose complete honesty there is absolutely no question.—*Engineering*, June 14, 1907, page 780. Editorial, "The Cordite Debate."

. . . . . All ships in the German Navy were fitted with apparatus to keep the magazine cool, but our Admiralty only seem to have appreciated the

importance of this during the past year, when the matter was forced on the attention of the Government by the accident on H. M. S. *Fox*, though several years previously a similar accident had occurred on H. M. S. *Revenge*. In both cases by a simple chance, the loss of the ships and their crews, fortunately, did not occur.—*Engineering*, September 27, 1907, Editorial, "Back-flash from Modern Smokeless Powder."

. . . . it has long been recognized that some cordites decompose slowly, and might finally ignite and explode spontaneously. The change is due to the absorption of oxygen from the air, O combining with N of cordite. In order to watch this gas absorption, about 50 grams of cordite are placed in an inverted glass cylinder, which a long bent gas tube connects to a mercury column pressure gauge; the apparatus, without the gauge, is placed in a water bath kept at 70° C. After a while the gas absorption passes into a gas evolution and expansion. The new method is the only reliable one which gives a timely warning that the sample of cordite is not to be trusted; and it is to be hoped that it will prove a safeguard against spontaneous explosions in powder magazines, especially in the tropics.—*Engineering*, June 22, 1911. "New Stability test of Cordite by Dr. Silberrad."

. . . . The usual objection put forth to the introduction of the nitro-cellulose powder is that it will not keep on foreign stations with variable climates. This I must state is erroneous—I have results of nitro-cellulose powders stored in some of the hottest climates, and these have proved in every way satisfactory, both chemically and ballistically, when fired in guns. Some of the great German chemists have had this powder under various heat tests for many years and have reported to me their definite opinion that nitro-cellulose powders, if properly made, are to be relied upon not to deteriorate any more than cordite and other nitro-glycerine powders when subjected to variable climatic influences.—*Engineering*, March 8, 1901, page 297. "Modern Artillery" by Lieutenant A. T. Dawson.

(See fuller quotation from this article in note I of the appendix hereto, together with note II, quoted from an editorial in *Engineering*, March 15, 1901, endorsing and commending Lieutenant Dawson's article.)

The most important considerations in determining the best composition of powder are (a) keeping qualities and safety under normal climatic conditions, (b) capability of highest possible ballistics, (c) regularity in results not to be seriously affected by change of climate, or not to cause excessive erosion. *All* these qualities are secured by the use of the properly manufactured nitro-cellulose powder, and *none* can be said to be met by any powder containing nitro-glycerine.—*Engineering*, Aug. 16, 1901. "Naval Ordnance," by Lieutenant A. T. Dawson, R. N.

(See fuller quotation from this article in note III of appendix hereto.)

To the above very conclusive testimony given by *Engineering* itself as to the instability of cordite, we add a few items from other English technical journals.

As a result of the terrible explosion on board the French battleship *Jéna* there has since been a thorough overhauling of the explosives stored

in the various arsenals and magazines in the United Kingdom, and large quantities of them have been condemned and are being destroyed. Similar measures were taken quite recently in India, being prompted by the deterioration of much of the cordite and other explosives that had been stored in the Indian arsenals and ordnance stores and which had resulted in several serious explosions and outbreaks of fire.—*United Service Gazette* (English), Oct. 31, 1907.

. . . . As all our readers are aware, cordite deteriorates with storage, and more quickly when subjected to changes of temperature. *Army and Navy Gazette*, June 15, 1907. "Cordite Scare."

All cordite of lots K. 408, size 30 and D. 887 size 45 M. D. is to be destroyed.—*United Service Gazette*, December 24, 1908.

Mr. Craig asked whether several recent deliveries of cordite for big guns supplied by the government factory and private manufacturers had been found too unstable after 40 days storage to warrant admission with safety into the service; and, if so, what steps were being taken to provide a stable explosive for the Navy?

Mr. M'Kenna replied, "It is not in the public interest to give the information asked for in the first part of the question. Investigation and experiments are continually in progress *with a view to further insuring the stability of cordite*."—*United Service Gazette*, May 5, 1910.

Coming now to a somewhat more detailed consideration of the points made by *Engineering* in the editorial of Oct. 6, the following assertions are noted as calling for remark: 1st., that nitro-cellulose powders are inherently less stable than nitro-glycerine powders; 2nd., that all smokeless powders are less subject to deterioration when freely exposed to the air than when enclosed in air-tight containers; 3d., that cordite is less subject to changes in contained moisture because it is to a large extent "water-proofed" by the mineral jelly which it contains, and that, as a result of this characteristic it may be, and actually is, carried on British ships in packages which permit free access of air; 4th., that the navies which use nitro-cellulose powder are those which have had most accidents from decomposition of powder.

The general subject of the decomposition of smokeless powder is too technical to be considered very fully at this point. The opinions of experts are quoted at considerable length in the papers appended to this article, and references are there given to other sources of information. We believe that an overwhelming proportion of the evidence available is in favor of the greater stability of nitro-cellulose powder.

It appears to be well established that nitro-cellulose, even when perfectly pure, has some tendency to decompose even at ordinary

temperature, and that this tendency increases as the temperature rises, becoming very marked, and increasing very rapidly, as we go above 90° F. Disregarding for the present the manner of stowage (whether with or without free access of air), this tendency is common to all powders, including cordite, which have nitro-cellulose for a base; and we find no evidence tending to prove that the tendency is checked by the presence of nitro-glycerine, or even that nitro-glycerine is, by itself, more stable than nitro-cellulose. Exactly the opposite appears to be demonstrated by the published results of researches at the Royal Arsenal Woolwich, which indicate that both heat and moisture—the two great enemies of smokeless powder—*produce more rapid decomposition of nitro-glycerine than of nitro-cellulose.*

(See note IV appended: "Nitro-cellulose versus nitro-glycerine," by Robert Robertson, of the Royal Arsenal, Woolwich.)

(See also note V appended: "The Hydrolysis of nitro-cellulose and nitro-glycerine," by Oswald Silberrad and Robert Farmer of the Royal Arsenal, Woolwich.)

Moreover, even the nitro-cellulose itself which enters into the composition of cordite differs from that used in nitro-cellulose powders, and in a direction which makes it distinctly less stable. The material used in cordite is more highly nitrated than that used in nitro-cellulose powders as manufactured in the United States; and is, for this reason, harder to purify, and less stable when it is purified. On this point the researches of Will and Jacques are conclusive, and are fully accepted by English authorities, as proving that the instability of nitro-cellulose increases directly with the degree of its nitration.

See "Nitro-cellulose; Researches on the stability of," by W. Will, *Journal of the Society of Chemical Industry.* Dec. 15, 1902.

Also "Treatise on Instability of Nitro-cellulose," by M. Jacques. *International Chemical Congress* (Rome) 1906. Also note VI appended to this paper giving an abstract of the above paper by Jacques.

It is manifestly impossible that the mere mechanical mixture, without chemical action, of two unstable substances, can produce a substance more stable than either ingredient; and as both the nitro-cellulose and the nitro-glycerine used in cordite are individually less stable than the less highly nitrated material used in United States powders, it is manifest that the mixture of these substances (which differs from cordite only in its form and in the absence of mineral jelly) is at a marked disadvantage

as compared with the nitro-cellulose of lower nitration, used, by itself, in United States powders.

A mixture of nitro-cellulose and nitro-glycerine such as is described above, without other solvents or stabilizers, is the explosive commonly known as "explosive-gelatine," or "blasting-gelatine." It differs from cordite in its form, which is that of a stiff jelly, and in the fact that it lacks the 5% of mineral jelly which acts as a stabilizer in cordite. The two substances have, however, very much in common, and are usually grouped together by writers on stability, as for example in the following very significant quotation from a recent work by Oscar Guttman, one of the highest authorities on the Chemistry of Explosives.

After referring in strong language to the inherent instabilty of nitro-cellulose, the author proceeds:

> . . . . No wonder that when nitro-cellulose is mixed with another explosive like nitro-glycerine to form smokeless powder it becomes less reliable, and acts detrimentally on the nitro-glycerine. This is accentuated still more in the presence of another disturbing factor such as heat or an alkali. I have seen cases of gelatine dynamite literally dripping with nitro-glycerine because a small quantity of ammonium carbonate, added as a so-called stabilizer, caused a decomposition of some of the nitro-cellulose, and this went on to such an extent that the absorbing power of the nitro cotton was destroyed.—*Twenty Years Progress in Explosives*, page 61.

It would seem to be clear from what precedes that cordite without its 5% of mineral jelly would be a very unstable substance. In fact, the stabilizing effect of mineral jelly, which had not before been suspected, was discovered through the alarming instability of certain lots of cordite from which this substance had been omitted.

The material of which our nitro-cellulose powders are made is comparatively stable in itself, and we have, associated with it even in our older powders—those which preceded the introduction of diphenylamine—a stabilizing agent which is at least as helpful as the mineral jelly used with cordite. This is the alcohol which remains in the powder after drying and persists almost indefinitely.

The direct action of the mineral jelly of cordite is, like that of the alcohol in nitro-cellulose powders, to neutralize the acid products of decomposition; but *Engineering* claims that it has a secondary and very important effect in that it forms a water-

proof coating on the outside of the powder grain and thus assists to keep the moisture of the grain from variations due to heat and dampness. It results from this, according to *Engineering*, that there is no necessity for keeping cordite in the air-tight containers which are used with nitro-cellulose powders, the disadvantages of which are that:

"hermetically to seal up a case of powder is distinctly deleterious in the long run to the chemical stability of the powder, more particularly in hot climates or in hot magazines; for if the gaseous products of decomposition are not allowed to escape, they have a cumulative effect upon the rest of the powder."

There is much reason to believe, although the demonstration lacks completeness, that such accelerated decomposition as is described above would actually take place under some conditions with non-colloided nitro-cellulose; that is to say, with pure nitro-cellulose, unassociated with the substances which are associated with it in smokeless powder.

Here we should have a tendency, which might conceivably prove a controlling tendency, for the acid products of initial decomposition to act by catalysis and produce further decomposition.

In the case of the finished nitro-cellulose powder, however, another and very important factor enters into the matter. This is the vaporized alcohol with which the sealed container is filled. This alcohol is a neutralizing agent for the acids of decomposition, and is thus, as has been noted above, a stabilizer for the powder. By the use of air-tight containers we insure the retention of the alcohol in contact with the powder, in quantity far more than sufficient to take care of such incipient decomposition as may develop.

Experiments have shown, moreover, that the pressure of the free gases within the closed container checks the evaporation of the alcohol from the powder and retains it *in the grain*, where its stabilizing effect is of maximum value.

This view of the effect of sealed containers upon the stability of powders made with an ether-alcohol solvent, has been very completely demonstrated by the eminent French scientist L. L'heure, the associate of M. Vielle, in an elaborate series of experiments which are fully recorded in the "*Memorial des Poudres et Salpetres*" No. XV, pages 1-38. (See note VII in appendix to this paper).

These experiments indicate clearly that nitro-cellulose powders, at least, when heated in closed tubes, retain their stability much longer than the same powders heated in open tubes with free access of air.

It is not demonstrated that the same is true of cordite; but if it is not, the question may well be asked, what is the status of the cordite which, in "fixed ammunition," is hermetically sealed up in cartridge cases? There are no statements which indicate that this powder is regarded by the British authorities as more dangerous than that which is put up in other containers. Moreover, the fact seems to be, as will be shown hereafter, that *Engineering* is in error in believing that even the large caliber charges of the English Navy are kept in containers which permit free access of air.

The statement that cordite can be carried, and in the British Navy *is* carried, is such a way as to permit free circulation of air, appears to be contradicted by the following extracts from the official "Handbook on Ammunition 1909—published by Authority of the Lords Commissioners of the Admiralty":

P. 41. Service ammunition is not to be passed for exercise, and is to be handled with great care. The ammunition boxes are packed in dry air, and should therefore only be opened when absolutely necessary.

P. 47. Rough usage of ammunition cases and their contents is calculated to cause mis-fires, hang-fires, or even premature explosion, and, further, ammunition boxes so handled cannot be expected to retain their air-tightness or the contents of their efficiency.

P. 48. The lids are made water-tight by well luted jute yarn, or hemp placed in the groove with more luting placed round the lid.

P. 48-49. Cylindrical cases are made of brass. The lids of all are made water-tight by being screwed up against a dermatine washer fixed by India-rubber solution. Air test plugs are fitted in the lid.

P. 49. Rectangular and cylindrical cases are now being manufactured with weakened ends, so that in case of premature ignition of the cordite charges the gases generated will burst open the cases and explode into the magazine, thereby minimizing the risk of an explosion.

P. 50. Outfit boxes for 6-inch, 4.7 inch Q. F. etc., guns are of teak, zinc lined. The box is made air-tight by luting placed in a recess round the lid.

P. 51. Boxes for 6-pdr. and 3-pdr. are made air-tight by luting the groove round the top edge.

P. 55. The luting which is used for making water-tight rectangular, and metal lined powder cases, and all Q. F. ammunition boxes, and for other purposes, such as making gas tight large base fuzes, etc., is composed of 80 parts of whiting, 20 of vaseline, and 1 part of castor oil.

It would appear from the foregoing extracts that cordite as used in the British Navy is carried in air-tight cases much like those used in the United States Navy and is subject to the same alleged danger of accelerated decomposition to which United States powders are exposed if the views of *Engineering* are correct.

The fact is, however, as has been already shown, that confinement in air-tight cases does not hasten but on the contrary greatly retards decomposition, and that Great Britain and all other powers which keep their powder in air-tight containers act wisely in so doing.

In this immediate connection, a recent experience of the United States Army Ordnance Department is interesting. A large quantity of small arms ammunition loaded with nitro-glycerine powder, having become obsolete because of changes in the service bullet and rifle, was to be broken up.

Examination showed that many of the necks of the cartridge cases were split, bringing the powder in contact with the atmosphere. In all such cartridges the powder was found to be in an advanced stage of decomposition while the cartridges which were intact and thus air-tight were in comparatively good condition.

It is probably true that the mineral jelly used in cordite does perform a useful function in closing the pores of the grains, thus making them comparatively impervious to moisture. We are inclined to believe that this is the one and only point of the article in *Engineering* which is well taken. Evidently, the effect of this is not what *Engineering* claims, for, as has been shown by quotations from the "Handbook of Ammunition," the cordite used in the British Navy is *not* kept open to the air. We believe, however, that the so-called "water-proofing" effect of the mineral jelly is a real advantage and that it cannot fail to be in some measure favorable to stability. This is the more fortunate because of the very rapid decomposition which has been shown to result *in cordite* from the presence of moisture. (See note V in appendix, on "The Hydrolysis of Nitro-cellulose and Nitro-glycerine.")

It is evident that without this water-proofing effect, the life of cordite would be extremely short when subjected to a moist atmosphere.

As the hydrolysis of nitro-cellulose is much less rapid, there is not the same necessity for "water-proofing," although it is quite possible that such an effect would be advantageous if it could be obtained without the sacrifice of other desirable qualities.

The claim that cordite is a tougher colloid than nitro-cellulose powder will not stand for a moment. The comparison is easily made and has often been made. The toughness of our powder is so great that if a grain of it is cut to a length equal to its diameter and subjected to compressive strain, it can be reduced to one-half its original length before a sign of cracking appears on the surface.

The following further extracts from the same British Naval "*Handbook on Ammunition*" which has been already quoted, call attention to another and very serious danger in connection with cordite, which alone should be sufficient to condemn it. This is the danger of *detonation* by shock—a danger which is here officially recognized as existing when the powder is in perfect condition, and which is, of course, enormously increased when the nitro-glycerine has exuded and collected, as nitro-glycerine pure and simple, with all the sensitiveness which is inherent in it, on the outside of the grains or the bags, or within the containing tanks and boxes.

P. 14. Susceptibility. Cordite of small diameter and in short lengths is very susceptible to explosion by concussion; this susceptibility diminishes as the diameter and length increase.

P. 14. Exudation. Cordite sometimes has the surface moist; this condition is called sweating. This is due to the exudation of nitro-glycerine, which is liable to take place when the cordite has been subjected to temperature below 45° F., and subsequently warmed. Below 45° F., the nitro-glycerine freezes, and crystalizes out on the surface, and the melting of these crystals forms the sweating.

P. 14. Sweating does not injuriously affect the cordite, and if it occurs in made up cartridges no action need be taken, but if it appears on cordite in bulk, the cordite is not to be handled till it recovers its normal state, which it will do if its temperature is kept above 45° F., by the reabsorption of the nitro-glycerine; when this has taken place it is serviceable.

If these statements or their significance needed confirmation, abundant testimony like the following could be adduced.

. . . . The great danger that arises from the storage of this nitro-glycerine series of explosives is that at a temperature which may be easily reached, and, indeed, can only be avoided by special precautions

in hot countries, nitro-glycerine will drain out of the mass and form an extremely dangerous residue . . . . .

. . . . The results are in accordance with what might reasonably be anticipated—the experiments certainly appear to bear out the contention that a great percentage of nitro-glycerine is very dangerous. It is said that as it exudes from the powder it collects on the cartridge cases or vessels in which the powder is contained, and may detonate at any time when exposed to shock . . . . .—*Engineering*, April 2, 1897, page 451, "Maxim's Testing Apparatus for Smokeless Powder."

The cordite which was in use at the above date contained a much larger percentage of nitro-glycerine than the present English service powder, "Cordite M. D." The difference, however, so far as the above phenomenon is concerned, is one of degree only, not of kind.

As to the statement that the navies which have had most trouble and accidents are those which use nitro-cellulose powders. It is not clear from the context whether the reference to accidents with nitro-cellulose powder has to do with "flare-backs," or only with accidents arising from the lack of stability of the powder; but as all other parts of the editorial in question relate to the matter of stability, it seems fair to assume that this part refers to the same subject. Viewed in this light, the association of the navies of France and the United States in a sweeping generalization as to accidents is hard to understand.

It has been very commonly assumed in England and on the continent, that the destruction of the *Maine* was—or may have been—due to smokeless powder. The fact is that there was no smokeless powder on the *Maine*, except a small quantity of small-arm ammunition which was in one of the magazines which did not explode. The United States Navy did not issue a smokeless powder for any guns except small arms until after the war with Spain. Recent evidence, moreover, has definitely fixed the cause of the destruction of the *Maine*.

The notable accidents, then, in which ships have been destroyed, presumably by smokeless powder, stand as follows:

Aquidaban, destroyed by *cordite*.
Jéna, destroyed by *nitro-cellulose powder*.
Mikasa, destroyed by *cordite*.
Liberté, destroyed by *nitro-cellulose powder*.

The accidents in the magazine of the *Revenge* and the *Fox*, due to the decomposition of cordite are referred to in articles already quoted from *Engineering*. Commenting further upon these and other accidents, and comparing cordite with the nitro-glycerine powders used in the German navy, *Engineering* says, editorially:

So far as keeping qualities are concerned, the German powder is even better than our cordite. This is also an important factor in view of the cordite explosions which have taken place in the magazines of British war vessels, fortunately, so far, without loss of life or of a ship; similar good fortune may not continue. The report on these explosions has been kept extremely quiet so that is is difficult to speak more fully of them; but on one occasion it was mere good luck that a battleship was not sunk with all hands. Owing to this immunity from disaster, the public have not had their faith in the safety of ships in our fleet shaken in the same way as France quite lately was rudely awakened from the confidence in the excellence of the propellent powder used in her Navy by the terrible disaster on the *Jéna.—Engineering*, Sept. 27, 1907.

It may be remarked in passing that the German powder which is referred to with so much approbation in the above editorial relies for its stability upon the same ingredient "diphenylamine" which is now used in all United States powders.

Apart from accidents on shipboard, the history of cordite and its allied explosives containing nitro-glycerine is filled with incidents like the following, extracted from the official reports of the British Inspector of Explosives:

Report of 1902:

Spain—On June 26th the school of gunnery magazine at Carabanchel camp exploded, killing two men and injuring fourteen others. There were several nitro-powders in the magazine and the explosion is attributed to the spontaneous ignition of unstable ballistite.

Report of 1904:

Fire in blending house in which were present 2300 pounds of cordite. No person was present in the house at the time.

Report of 1904:

Australia—Great excitement at Coolgardie on May 19th when a twenty ton licensed magazine blew up. There are strong grounds of suspicion that the explosion was due to the spontaneous ignition of some nitro-glycerine explosives.

Report of 1905:

A magazine belonging to the Thames Storage (explosives) Company Limited, in which a quantity of small-arm nitro-compound had been kept

for considerable time was burned to the ground. The fire was most probably due to spontaneous decomposition.

Report of 1909:

On September 21st an ignition of cordite M. D. occurred in the magazine of the Small Arms Ammunition Factory, Kikee, India. The fire was attributed to the spontaneous ignition of the cordite, M. D., but no reason for this could be assigned.

Report of 1907 (Inspector in India):

The two explosions of cordite which occurred at Hyberdad on the 7th and 15th of April, 1906, and at Ferozepore on the 31st of August, 1909. Special boards of investigation arrived at the conclusion that the explosions were due to the spontaneous ignition of cordite from some cause or other. Below is given a record of nitro-compound explosions which have occurred in India previous to the explosions of cordite referred to above.

In 1888	explosion	of	two magazines.
In 1890	"	"	one magazine.
In 1891	"	"	one "
In 1896	"	"	one "
In 1898	"	"	two magazines.

All these explosions were attributed at the time to the spontaneous ignition of blasting gelatine owing to chemical deterioration.

Report of 1899:

An accident in the manufacture of cordite occurred at the factory of Kynoch at Holehaven. Some cordite which was being examined on a table took fire and ignited a considerable quantity of the same explosive which was present in the building. An exhaustive inquiry failed to reveal any cause to which the ignition could be attributed with any degree of probability.

It is probable that the above partial list of accidents could be more or less completely duplicated from the history of French nitro-cellulose powders, which are now known to have been manufactured, stored and tested with so little care that they have practically nothing in common with our powder except the fact that they contain no nitro-glycerine.

The chief significance of the above list lies in the evidence which it affords that cordite has no claim to the immaculate record which *Engineering* has been moved to assign to it at this late day, after many years of such condemnation as has been illustrated in various quotations already given.

The experience in this country with cordite and other nitro-glycerine powders has not been such as to inspire confidence in their stability. A large quantity of cordite purchased with the

"*Albany*" and "*New Orleans*" was destroyed as unsafe within a few years after its arrival. The exact dates are not at hand, but the life of the powder was much less than ten years.

Approximately 70,000 pounds of cordite purchased in England in 1898 by the U. S. Army, made up into charges for the 4.7-inch and 6-inch Armstrong guns, was destroyed at Picatinny Arsenal in 1908, it having become so unstable as to be in a dangerous condition. Its condition was indicated by the fact that it gave a KI starch test of only four minutes at 82° C., and that it gave dangerously high and irregular pressures in firing.

A further important feature of our experience with cordite and other nitro-glycerine compounds is that when decomposition does set in it proceeds much more rapidly than in the case of nitro-cellulose powders. And, what is of still greater importance, that *the decomposition is much more likely to terminate in an explosion.*

The gradual progress of such decomposition as may occur in nitro-cellulose powders is one of the most satisfactory guarantees which could be wished, that the change will be detected by the very complete tests which are a matter of routine, long before it can become dangerous. Nitro-glycerine powder, on the other hand, after remaining apparently unchanged for a considerable length of time, is apt to develop instability quite suddenly and rapidly. We have just had a confirmation of this in the case of some nitro-glycerine powder at Frankford Arsenal. This powder showed no marked change in stability from the date of manufacture in 1900 until March of this year. Between March and November, however, it lost stability very rapidly and was destroyed. In March it withstood the 135° C. test for seven hours without exploding and gave a surveillance test at 80° C. of 16 days. In November, five samples exploded in less than two hours at 135° C. and the surveillance test at 80° C. had dropped to seven days.

A similar case of very sudden deterioration in a nitro-glycerine compound is mentioned by J. B. Henderson and T. McCall in an article published in the *Journal of the Society of Chemical Industry* for March 15, 1910. This is the case of a lot of blasting gelatine manufactured Feb. 4, 1909.

On Sept. 9, 1909, this lot was tested and found to be in good condition. On Dec. 15, it was in a dangerous condition, decomposition having set in accompanied by exudation if the nitro-glycerine.

While our experience with nitro-cellulose powder has not been absolutely uniform, it has included but four incidents in which suspicion has fallen upon the stability of the powder. Three of these go back to the very infancy of the manufacture in this country, and the powders involved had been made by methods which were discarded almost immediately afterward. The fourth accident was a fire originating in a powder charge which was being handled at the New York Navy Yard in transfer from the *Culgoa*. No evidence has ever been found that the powder was at fault, and prolonged experiments with a large number of samples of the same powder with the same history, have failed to develop any indication of instability. We have on hand at present many lots dating from the first few years of our manufacture of smokeless powders, about 1900, which are still in good condition.

Within the current month (December, 1911) reports have been received from a number of lots of powder manufactured in 1898 which were sent to Culebra, West Indies, in 1902 and of necessity stored for a number of years in a way which represented very nearly the maximum of unfavorable conditions as to heat and moisture, being subjected to extreme alternations as regards both of these factors. For the first year it was kept in a leaky coal barge, painted black, exposed to the sun, without ventilation; and thereafter, for about 8 years, in a hot and damp underground magazine.

This powder has recently been returned to this country and has been examined at the Fort Mifflin Magazine. A considerable part of it is still in good condition. Several lots, however, which show signs of having suffered more than the others from exposure to moist heat, have decomposed into a pasty mass which deliquesces upon exposure to the air. Not only did none of this powder explode as a result of decomposition, but there is no evidence of any marked rise in temperature having taken place. This evidence is a strong confirmation of the statement already made, that the disposition of nitro-cellulose powder when it does deteriorate is to do so with comparatively slow evolution of heat

and with *little or no tendency to explode*. It also confirms the claim that, in general, our powders—even those which contain no stabilizer—retain their stability for long periods in spite of unfavorable conditions.

The writer in *Engineering* alludes to the matter of *erosion* but dismisses it as if it were of little consequence, with the remark that: "experiments have shown that erosion is not only a function of the temperature of explosion but also of other factors which tend to counterbalance the advantages of the lower explosion temperature."

It is doubtless true that other factors than temperature have their effect upon erosion, but these effects are comparatively trifling, and even at that, there is no evidence that they are less important in cordite than in nitro-cellulose powder. All authorities agree that, broadly speaking, erosion is a direct result of the temperatures to which the bore of the gun is subjected by the combustion of the powder charge, and all authorities are equally agreed that this temperature is something like 50% greater with cordite than with nitro-cellulose powder.

There have been no experiments since those of Sir Andrew Noble, in 1900, which have thrown any doubt upon the *results* which he records in the following words:

> From the curve showing the quantities of heat you will note that in passing from 10% nitro-glycerine to 60%, the heat generated has increased by about 60%. But if you will examine the curve indicating the corresponding amount of erosion, you will see that while the heat is only greater by about 60%, *the erosion is greater by nearly 500 per cent.*
>
> These experiments entirely confirm the conclusion at which I have previously arrived; viz., that heat is the principal factor in determining the amount of erosion.

It should be noted that these experiments cover a range which begins far below the percentage of nitro-glycerine in cordite M. D. (30%) and ends slightly above that of the orginal cordite (58%).

The following editorial in *Engineering* under date of March 15, 1901, gives some interesting facts with regard to the erosion resulting from the use of the unmodified cordite of that day, with its 58% of nitro-glycerine:

> Cordite is the powder in use in all our guns, and it has had its trial in the South African war. What are the results? It is no secret that

the erosion with cordite is most excessive, and we believe that this is even with guns not designed to give the highest energies now necessary in modern artillery. We understand that many of our field pieces in the Transvaal have been returned "badly eroded," and, further, that many of the 4.7-inch guns in the Transvaal, supplied by the Navy from Simon's Town, had to be replaced, owing to the wear in the bore quite spoiling the shooting. As an instance of the irregularity, we may mention that the firing of the 4.7-inch gun varied in range by over 400 yards. This fact alone demonstrates to the country the serious peril involved in continuing the use of cordite. It is obvious that if these disadvantages are now appearing in the present conflict, in which but a comparatively small number of guns are being utilized, a very lamentable position would be created if we were at war, say, with two first-class maritime powers, in which the long range and the efficiency of the guns must practically control the final result. It surely is a very short-sighted policy not to take active measures when such facts are well known.—*Engineering*, March 15, 1901, "Smokeless Powder."

A comparative study of nitro-glycerine versus nitro-cellulose powders from the point of view of erosion has recently been made by the Ordnance Department of the United States Army, with results which fully confirm those obtained by the British authorities already quoted. These firings were made in 1907 with the 30-caliber rifle. Two of the powders used contained 20% and 30% of nitro-glycerine (the larger per cent being practically that which is incorporated in the latest British powder, cordite M. D.).

The accuracy-life of the rifle was found to be as follows:

With 30% nitro-glycerine powder .. 2000 to 3000 rounds
With 20% nitro-glycerine powder .. 3000 to 4000 rounds
With nitro-cellulose powder ..... 12,000 to 15,000 rounds

After 2000 rounds, the mean absolute deviations at 1000 yards of the rifles using the different powders were as follows:

With nitro-cellulose powder ..... 15.2 inches
With 20% nitro-glycerine powder ..... 16.6 inches
With 30% nitro-glycerine powder ..... 26.6 inches

After 3000 rounds, the deviations increased to the following:

With nitro-cellulose powder ..... 15.7 inches
With 20% nitro-glycerine powder ..... 18.6 inches
With 30% nitro-glycerine powder ..... 37.4 inches

After 4000 rounds, the deviations increased to the following:

With nitro-cellulose powder ..... 16.3 inches
With 20% nitro-glycerine powder ..... 26.5 inches
With 30% nitro-glycerine powder .....Accuracy entirely lost, rifling practically destroyed.

After 5000 rounds, the deviations were:

With nitro-cellulose powder ..... 16.9 inches
With 20% nitro-glycerine powder .....Accuracy entirely lost, rifling practically destroyed.

After 15,000 rounds, the deviations were:

With nitro-cellulose powder ..... 24.5 inches

Thus the rifle using nitro-cellulose powder was in better condition after firing 15,000 rounds than the one using 30% nitro-glycerine after 2000 rounds and better than the one using 20% nitro-glycerine after 4000 rounds.

The two series of experiments above described, by Sir Andrew Noble and the United States Ordnance Department, are the only ones with which the Board is acquainted in which the firings were pushed to a final conclusion, and it will be observed that the results of the two series are in substantial accord, and that they agree entirely with the view expressed by *Engineering* in the article just quoted from the issue of March 15, 1901.

The claim has been made in the preceding pages that there are good and bad nitro-cellulose powders, just as there are, doubtless, good and bad nitro-glycerine powders; and that the powders which have caused the recent terrible disasters in France may fairly be classed as bad upon evidence derived entirely from official French sources.

This evidence, which has been so widely published that it seems unnecessary to reproduce it here, indicates that in manufacture, storage and inspection, the methods used and the precautions taken have been such as almost to invite disaster.

The practice has obtained, for instance, of subjecting old and bad powders to a process of retreatment ("radoubage") and from that time forward regarding them as if they were new powders, issuing them to service with the date of retreatment as if this were the date of manufacture. It is, of course, possible to re-work old powders with so much completeness as will make them actually new. This is the case with the process of re-working which is used with United States powders, to which reference has already been made. Here the powder is ground up into finely divided particles of nitro-cellulose, which is then subjected to all the stages of washing, boiling, etc., through which it passed

in original manufacture, the diphenylamine being introduced at the same stage of manufacture, and every step of the original process being duplicated with absolute thoroughness. The French have a process of re-working ("ramalaxage") which, while much less thorough than our process just described, is much superior to their "radoubage," which was in use until 1907, which latter process consisted only in an attempt to restore the solvents which had evaporated from old powder, by soaking the grains in ether-alcohol solvent to which was added a small percentage of amyl-alcohol.

To subject a powder to such treatment as this and then regard it as new powder, dating from the date of this treatment, would seem to be bad enough, but with this practice was associated another which was even worse. This was to *blend* several lots of powder made at different times, with entirely different histories —some perhaps retreated and others not—and to issue them to service with a single designation as if they were of a single homogeneous lot, of one date of manufacture and one consistent history. It is clear that not only did the bad powders of such a blend entirely neutralize the good ones, but that no test could possibly have any value because it could not be representative of the whole lot.

It is an extraordinary and very significant fact that the powder which destroyed the *Liberté* (if indeed the fault actually lay in the powder) is thought to have been identified as being practically the same as that which destroyed the *Jéna;* that is to say, it was made at the same factory (Pont de Buis) at very nearly, if not exactly, the same time (1906) and by the same methods—methods which a later manager of the factory has condemned as criminally careless.

1. The explosion of the *Jéna* was caused by powder made by the factory in Pont De Buis. The explosion of the *Liberté* was caused by powder from the same source, but whose manufacture dates from the beginning of the year 1906.

2. At the end of the year 1906, the director of the factory of Pont de Buis was sent to that of Moulin Blanc and replaced by M. Maissin. The latter furnished, in 1907, a report in which he formally accused his predecessor of carelessness. In a manner very precise, he indicated that powder of bad quality had been retreated (that is to say indifferently restored by different chemical processes) at Pont de Buis, and delivered next, like new powder; *while giving for the date of its manufacture the date of the retreating.*

"These are are powders," said M. Maissin, "which have caused the catastrophe on the *Jéna*." "These are also those which caused that of the *Liberté*." The result of the actual investigation permits us to affirm in a manner almost positive that the exposion was due to the inflammation of a cartridge in the upper magazine of the starboard forward side. This magazine contained only the lot of powder B. M. 13 A. M. 8-2, 06. P. B. (Second lot 1906, Pont de Buis.)

All the artillery officers know that the dates of the lots of powder which are issued to them are absolutely illusory.—"*Le Matin*," October 25, 1911.

A lot is taken which has been proved in a gun. If, for example, the velocity obtained is greater by 15 or 20 meters than that which is desired, another lot is taken which gives a velocity too low. The two lots are mixed and so, by trying many mixtures of powder of different dates and origin, a mixture is obtained having the desired velocity.

At the time of the inquiry of the *Jéna*, there were many discussions on the very grave inconveniences which these mixtures presented, and notably Colonel Jacob was very explicit in this regard. He considers that the greatest improvement in manufacture will be to have unmixed lots.

The reason is simple. If you wish, in the sequel, one year after, two years after, to render account of the state of your powder, how would you do so with the tests admitted hitherto? You take off a sample and you see if it decomposes too rapidly at 110°. But, if you have in the lot which you examine several powders of very different origin, all that you will know is that the particular grain from which you have taken the the sample, is good; but can you say that another grain of the mixture, made at another time, will be good also?

It is certain that this sampling made at random will be good only if we have to do with a homogeneous lot.—*Statement by M. Paul Painleve, Chamber of Deputies Inquiry. Nov. 11, 1911. Page 2982.*

. . . . Among the memoranda of lots of powder issued to the Navy which have passed through my hands, is one which deals with a mixture so extraordinary that I think it my duty to communicate it without delay to the Budget Commission.

The lot of 15,124 kilos., dated 1909, included 8474 kilos., of powder finished in 1908, 4501 finished in 1906, 763 kilos., of remnants marked 1906, and 1386 of a mixture bearing the same date. This mixture is composed of powders which go back to 1904 and perhaps earlier. It is important to observe that this lot does not come from Pont de Buis, but from Sevran-Livray.

. . . . At Point du Buis, even very recently, the most extravagant mixtures were common. It is curious to note, under the administration of M. Maissin, more serious faults than those which he charges so bitterly against his predecessor. For example, a lot of powder dated 1908 contained a large proportion of powder retreated (radoubé) in 1901, and

therefore actually manufactured perhaps 5 tor 6 years earlier—so that the lot marked 1908 contained in reality powders of 1895 and 1896.—*Statement of M. Paul Painleve, Reporter of the Budget, in the Chamber of Deputies.*

The following note illustrates still another phase of this matter.

"It is well known that naval officers are charged only with the utilization of the artillery on board ship. The powders are delivered to them under the direction of the artillery-of-the-port, by the engineers of the artillery, a body entirely distinct from that of the naval officers.

Reliable information permits us to affirm that the orders of the artillery have not always executed promptly the ministerial regulations ordered after the catastrophe on the *Jéna*.

They had still in the squadron last Tuesday, Sept. 30, 1911, ammunition 13 or 14 years old. They delivered to the ships of the Third Squadron at Brest, before its departure for Toulon, the retreated lots, expressly prescribed since the *Jéna*. The commanders protested. The reply to them was, "There is no other powder." They had to take those powders on board.

The regulations for the conservation of powder says: "Ammunition should be inspected if it has undergone 35° for 14 days or 30° for 90 days."

Before the manœuvers the Charles Martel demanded the inspection of the magazine which had been subjected to this condition. It was refused. On board they had doubts about the lot; there were brown spots on the grains in the observation flask, which indicated a decomposition of the lot. The matter was referred to the artillery. A chief engineer came on board. He examined the grains and said, "There are evidently gunners who have placed their dirty hands on it."—"*Le Matin*," October, 1, 1911.

The latest news from France is to the effect that an entirely new system of supervision has been established by which the officers of the Army and Navy who are to use the powders, are given not only the privilege but the duty of supervising every stage of the manufacture of the powders and every feature of their subsequent life and treatment.

The new rules, established by a decree of the President of France, are quoted in the appendix in Note VIII. They correspond almost absolutely with the rules which have been in force in the Army and Navy of the United States from the earliest days of the manufacture of smokeless powder in this country.

Regarding the conditions to which the powders are exposed on board ship, we have already quoted the views of *Engineering*, as set forth in its editorial of October 30, 1908, following an analysis

of the conditions brought out by the *Jéna* investigation. For convenience of reference, the following paragraph is again quoted:

. . . . it is quite clear that the disaster on board the *Jéna* was due to faulty location of the ammunition magazines and to imprudence generally. From this speech it is evident that the smokeless powders of any nation—and they are all practically the same composition—would have behaved in the same way in similar circumstances.—*Engineering*, October 30, 1908, Page 579. Editorial, "Smokeless Powders."

Without going as far as *Engineering* goes in this paragraph, we are unable to resist the conclusion that, to the danger inherent in powders badly made and imperfectly inspected, there was added, quite unnecessarily, in the *Jéna*, the *Liberté* and other French battleships, the danger arising from heat and moisture beyond what should have been tolerated and, we hope and believe, very far beyond what would be tolerated on a battleship of the United States Navy.

The criticism which has been so freely indulged in above of French methods of manufacture and treatment of their powders finds its justification in the fact, that, as already stated, every statement here given is taken from official information frankly given to the world by the French Government in an earnest endeavor to go to the heart of the causes which have resulted in the recent deplorable accidents to its Navy.

The statements made by *Engineering* with regard to the governments which use nitro-cellulose, and those which use nitro-glycerine, powders, are far from covering this ground completely, and as they stand may well convey an entirely false impression. There is no doubt that nitro-glycerine powders have certain rather marked advantages in convenience. And it happens that these advantages are such as to be especially important on ship-board. Other things being equal, the energy desired is obtained with materially smaller weight and bulk of cordite than of nitro-cellulose powder. This means not only that more rounds can be carried in the magazine but that the charges can be handled more easily and in smaller space, from which condition there follows a possible saving in the size and therefore in the weight of the turret. The smaller charge calls for a smaller powder chamber and this permits a shorter gun. All of these advantages are freely conceded. They have to do with *convenience*, not with *safety;* but in the judgment of certain governments they have sufficed to outweigh—in their application to ships—the advantages

of a widely different character which are very generally attributed to nitro-cellulose powders and which have been set forth in the preceding pages of this paper. It is peculiarly significant that, as pointed out by *Engineering*, Germany and several other powers, while using nitro-glycerine powders for the Navy, where the above advantages are important, use nitro-cellulose powders on shore, where matters of convenience are of little or no importance and where, accordingly, there is nothing to prevent the selection of the powder which is considered most advantageous from the view points of stability, erosion, etc. Granting that Germany feels bound to use nitro-glycerine powder for the Navy, there must be some very strong reason for accepting the inconveniences of using an entirely different powder for the Army. And so with all other powers which adopt this policy.

Again, it is hardly fair to count Japan, Argentina and Brazil as committed to the use of nitro-glycerine powders for naval purposes as a matter of deliberate policy. It has already been explained that guns designed for cordite have smaller chambers than those designed for nitro-cellulose powder. It follows from this, that a nation whose naval guns are of English manufacture and therefore designed for firing cordite is practically forced to use cordite for the Navy. If such a nation uses nitro-cellulose powder for the Army, this fact would seem to indicate a preference for the latter type of powder.

It has been reported from time to time that Japan was dissatisfied with cordite as a result of the destruction of the *Mikasa* and of the rapid erosion of the guns of all battleships during the war with Russia.

So far as England is concerned, we need not seek far for the explanation of her adherence to cordite. She has an enormous number of guns—on ship board, in fortification and in reserve—all of which have the small chambers which are characteristic of guns designed for cordite; and the magazines, turrets and ammunition-hoists of her ships are designed for handling the comparatively small and light charges of cordite which belong to this design. It is easy to imagine the difficulty and the expense which would be connected with a change to nitro-cellulose powder. And it is not difficult to imagine the panic which would follow the announcement that such a change was necessary. It is probable that all was done which could be done with prudence when the change was made from cordite mark I with its 58% of

nitro-glycerine, to cordite M. D. with 30%. This was a long step toward a nitro-cellulose powder and it is reported to have been a marked improvement.*

Looking at the matter from a view point broad enough to include both the armies and navies of military powers, and accepting the authority of *Engineering* as to the powders used, the list is as follows:

Nitro-glycerine Powder.	*Nitro-cellulose Powder.*
British Army	French Army
British Navy	French Navy
Italian Army	Russian Army
Italian Navy	Russian Navy
German Navy	United States Army
Japanese Navy (has heretofore used English guns)	United States Navy
	German Army
Argentina Navy (?) (has heretofore used English guns)	Japanese Army
	Argentina Army
Brazilian Navy (has heretofore used English guns)	Brazilian Army

(Signed) AUSTIN M. KNIGHT,
Rear Admiral United States Navy,
President of Board.

(Signed) ODUS C. HORNEY,
Lieutenant-Colonel United States Army,
Member.

(Signed) J. H. HOLDEN,
Lieutenant-Commander United States Navy,
Member.

(Signed) EDWARD P. O'HERN,
Major Ordnance Department United States Army,
Member.

(Signed) WILLIAM A. PHILLIPS,
Major Ordnance Department United States Army,
Member.

(Signed) W. L. PRYOR,
Lieutenant United States Navy,
Member.

* NOTE BY EDITOR NAVAL INSTITUTE PROCEEDINGS. Since the above was written, information has been received of a further reduction in the nitro-glycerine of cordite, which is now fixed at 23.5%. It is unnecessary to point out that this is a still closer approach to a pure nitro-cellulose powder.

APPENDIX

NOTES.

I. Modern Artillery—Lieut. A. T. Dawson, Late R. N. in *Engineering* March 8, 1901, Page 297.

II. Smokeless Powder—Editorial, *Engineering*, March 15, 1901.

III. Naval Ordnance—Lieut. A. T. Dawson, Late R. N. in *Engineering*, August 16, 1901, Page 234.

IV. Decomposition of Nitro-glycerine—Robert Robertson of the Royal Arsenal, Woolwich. Abstract of article in *Transactions of International Congress of Applied Chemistry*, 1909.

V. The Hydrolysis of Nitro-cellulose and Nitro-glycerine by Oswald Silberrad, Ph. D., and Robert Farmer, D. Sc., Ph. D., of the Royal Arsenal, Woolwich. Abstract of article in the *London Chemical Society Journal-Transactions*, 1892-1906, Page 1761.

VI. Treatise on the Instability of Nitro-cellulose—M. Jacques. Abstract of article in the Transactions International Chemical Congress-1906.

VII. Note on the Stability of Poudre B.—L. L'Heure. Abstract of article in *Memorial des Poudres et Salpetres*, XV. 1-38.

VIII. Inspection Powder and Explosives for the Use of French War and Navy Departments.

NOTE I.

Modern Artillery. Lieut. A. T. Dawson, Late Royal Navy. *Engineering*, March 8, 1901, page 297.

". . . . As to the type of powder to be used as a propellant, there is now practically no difference of opinion throughout Europe and America, the nitro-cellulose being preferred on all hands. The United States, Russia and France have adopted the nitro-cellulose form for sometime. Germany has been late in its adoptance, having used a form of nitro-glycerine powder containing about 25% nitro-glycerine but has now practically, I believe, decided to adopt a nitro-cellulose powder. Other small countries in Europe have not definitely decided on a particular type of explosive and may be generally said to be carrying out experiments. The fact, however, of nearly all the great countries of

the world, excepting our own, having adopted it, is to some extent a reason why our government should give it the greatest consideration. At the present time Great Britain is using cordite containing about 57% of nitro-glycerine. This powder has now been in use for about nine years, and in its day may be said to have been one of the best known explosives at the time of its introduction; it was absolutely necessary for our naval supremacy to introduce a smokeless powder; hence, I would represent that at that time Great Britain acted advisedly. The experience of the French until quite recently cannot be said to have been too highly satisfactory, as all will recall the serious explosion at Toulon not many years ago, which we have every reason to know was due to a deterioration of the powder in storage. Furthermore, I understand that the Russian Government's experience until 3 or 4 years ago was not all that could be desired, the nitro-cellulose from which it was made not being of the finest quality. In the United States they have now generally adopted nitro-cellulose powder in their fleet, and are introducing it into their land service. I understand the experience with this powder in the U. S. Navy is everything that could be desired, although I believe they are constantly carrying out experiments with a view of improvement. The United States land service, however, have until quite recently used a nitro-glycerine powder containing about 10% of nitro-glycerine. The experience they have had with their powder has been anything but satisfactory, and on many occasions they have had serious high pressures in their guns, in some cases completely destroying the artillery using it. The experiences of foreign powers tend to show the wise policy of the British Government in not adopting a nitro-cellulose powder at the time of its original initiation. Since that period, however, the manufacture of nitro-cellulose powders has very greatly improved, and the powders now being adopted by Russia and Germany are quite as safe in their use as cordite and other known modifications of cordite having various percentages of nitro-glycerine.

"Nitro-cellulose powder has the great advantage of being capable of producing in modern artillery the highest possible ballistics with the least possible amount of wear to the gun; and therefore at the moment its introduction should be treated from a most serious standpoint. . . . . In guns of low power using

cordite the effect of erosion is, of course, much less than in guns using large charges; but I contend that as it is necessary for modern artillery, except that for special purposes, to have the highest possible ballistics, it is of primary importance to use a powder which, as far as possible, gets over the objections I have just mentioned.

"The usual objection put forth to the introduction of the nitro-cellulose powder is that it will not keep on foreign stations with variable climates. This I must state is erroneous—I have results of nitro-cellulose powders stored in some of the hottest climates, and these have proved in every way satisfactory, both chemically and ballistically, when fired in guns. Some of the great German chemists have had this powder under various heat tests for many years and have reported to me their definite opinion that nitro-cellulose powders, if properly made, are to be relied upon not to deteriorate any more than cordite and other nitro-glycerine powders when subjected to variable climatic influences.

"I have heard it sometimes said abroad that better ballistics can be obtained in a rifle using nitro-glycerine powders as against cartridges made up of nitro-cellulose powders. This belief is unfounded, as I have been able to obtain from rifle cartridges of the smallest size used in Europe, higher ballistics with nitro-cellulose powder than with cordite at normal temperatures, say, between 60° and 70° F.

"Having laid particular stress on the importance of nitro-cellulose powders because they are the only ones by which we can obtain constant high velocities up to say 5000 f. s., I will now call your attention to my dangerous space diagram, showing the difference between the effect of firing with a high velocity . . . ."

NOTE II.

Smokeless Powder. *Engineering*, March 15, 1901. "Editorial."

". . . . Cordite is the powder in use in all our guns, and it has had its trial in the South African war. What are the results? It is no secret that the erosion with cordite is most excessive, and we believe that this is so even with guns not designed to give the highest energies now necessary in modern artillery. We understand that many of our field pieces in the Transvaal have been returned "badly eroded," and, further, that many of the 4.7-inch guns in the Transvaal, supplied by the Navy from

Simon's Town, had to be replaced, owing to the wear in the bore quite spoiling the shooting. As an instance of the irregularity, we may mention that the firing of the 4.7-inch gun varied in range by over 400 yards. This fact alone demonstrates to the country the serious peril involved in continuing the use of cordite. It is obvious that if these disadvantages are now appearing in the present conflict, in which but a comparatively small number of guns are being utilized, a very lamentable position would be created if we were at war, say, with two first-class maritime powers, in which the long range and the efficiency of the guns must practically control the final result. It surely is a very short-sighted policy not to take active measures when such facts are well known.

"Lieutenant Dawson strongly advocates the use of some form of nitro-cellulose—a compound now adopted by most of the first-class powers, and in his lecture he demonstrated its many advantages; but in a leading article of the "*Times*" of the 7th inst., on Lieut. Dawson's address, it was stated that 50% more nitro-cellulose powder was necessary than of cordite to obtain the same velocity, and, furthermore, that the cost of this powder was three times, and possibly four times that of cordite. These two statements have been met by Lieutenant Dawson in a letter to our contemporary on the 9th inst. He proves the statements to be misleading by giving the results of experiments with a 6-inch (45 cal.) gun, in which a charge of 28.6 lbs of cordite gave a velocity of 2875 f. s., whereas 36 lbs. of Rottweil powder (the German nitro-cellulose compound) gave 2910 f. s. in the same gun. The energy corresponding to a velocity of 2910 f. s. is 5872 foot tons, while the energy of the same gun at present in the service using cordite giving a velocity of 2530 f. s. is only 4438 foot tons, showing that if nitro-cellulose powder is used an increase of energy of 1434 foot tons, equal to 32%, is possible. Such an increase of energy by the use of nitro-cellulose powder fully warrants our seriously drawing attention to the necessity for the immediate introduction of a new type of powder.

"As to the relative weights of charges with nitro-cellulose powder and cordite, we understand that should it be decided to keep to practically the same energies with existing guns, but making use of a nitro-cellulose powder, which will more than double their lives and preserve the shooting of the guns efficient

during such life, the charges would not have to be increased in weight by much more than from 5 to 10%.

"Now at the present moment the country is committed to the purchase of many hundreds of the latest type of 6-inch quick firing guns, and a very large number of the heaviest pieces of artillery are now being prepared for installation in our principal fortresses. The question of the powder which is to be used for these guns must now be settled. It is true that for many months there has been sitting, under the Presidency of Lord Rayleigh, a committee, in whose hands we believe the question of the introduction of explosives now rests. We hope for the good of the country that the committee will soon see their way to make a specific recommendation, having in view this large amount of modern artillery which is being obtained for both our fleet and land service, and the consequently serious consideration of what modern explosive should be made use of in connection with this artillery. We do not think it can be too forcibly represented that the committee should, with the knowledge which they must now have accumulated, be in a position to make some recommendations, so that the new artillery now entering the services may have the advantage of using, at all events, what they believe at the present time to be the most suitable explosive. If the purpose of the committee is to develop a new cannon powder, we fear that the position of this country must in the meantime seriously suffer, for it should be patent to all that to go on amassing many thousands of tons of an explosive well known to be inferior to what other countries are using, may be a serious detriment to our interests, and tend politically to embarrass us. The large production of nitro-cellulose powder going on in Russia, France, and Germany should surely be an example to ourselves, who have for many years used an inferior makeshift, and should receive the attention of those now highest in power and responsible for the defenses of this country. . . ."

NOTE III.

Naval Ordnance. Lieutenant A. T. Dawson, Late Royal Navy. *Engineering*, August 16, 1901, page 234.

"The most important considerations in determining the best composition of powder to be adopted are, firstly, its keeping qualities and safety under normal climatic conditions; secondly,

its capability of obtaining the highest possible ballistics, and consequently the flattest trajectory; and thirdly, its regularity in results, so that the ballistics may not be seriously affected by change of temperature or by the wearing away of the gun due to excessive erosion. All these qualities are secured by the use of a properly manufactured nitro-cellulose powder, whereas none of these conditions can be said to be met by any powder containing nitro-glycerine.

"At the present time the Russian Goverment manufactures the largest quantity of nitro-cellulose powder. Up to about two years ago all the conditions enumerated were not fulfilled, owing to the nitro-cellulose used for the powder not being quite satisfactory; but since then they have obtained the best results by using the system employed by the Cologne Rotweil Company at their factory at Schluselburg. In France and Russia also great difficulty was experienced at the outset in obtaining a really suitable nitro-cellulose, and in carrying out the necessary operations to render the powder really homogeneous and safe. Indeed, it is only by careful study and much experiment that the manufacture of nitro-cellulose powder has now become really reliable and stable. The most serious experimental work in connection with this matter has been carried out by the Cologne Rotweil Company, at whose establishment extensive chemical research is always in progress. The Russian Government realized this some years ago, and in consequence gave this company a large number of orders, rendering it possible for them to establish large works in Russia for the development and manufacture of this highly important artillery necessity. Thus the average production in Russia of nitro-cellulose powder, manufactured upon a Rotweil system, amounts now to about 400 tons per annum.

"It may not have been quite appropriate to introduce the subject of powder into a paper on the mechanical engineering details of ordnance, but the reference made is probably justified by the important results following from the use of propelling powder of the nitro-cellulose composition. Indeed, it is, in the author's opinion, the only suitable compound for use with high-power artillery, and as experiments have convinced the author that powders containing even a small proportion of nitro-glycerine are unsuited to guns developing high velocity, he believes that the British authorities would be well advised in adopting the nitro-

cellulose compound. Difficulties, no doubt, would attend such change at the outset; but the wear of the guns at present, with all attendant disadvantages, makes the alteration almost imperative, especially when great power and rapidity of fire are sought for, as erosion increases at a much higher percentage with nitro-glycerine, and necessitates an exceptionally large reserve of guns being kept.

NOTE IV.

Decomposition of Nitro-glycerine. International Congress of Applied Chemistry, 1909. Robert Robertson, of the Royal Arsenal, Woolwich. (Abstract.)

"Will (Untersuchungen über die Stabiltät von nitrozellulose, 1 and 2, Mitt. Zentrablatt.) in his experiments arrived at the conclusion that a normal or intrinsic decomposition is characteristic of cellulose nitric esters, including gun cotton. The rate of decomposition of pure nitro-cellulose is a function of the temperature *and degree of nitration.* Instability may be detected by irregularity in decomposition or by an abnormal coefficient of N evolution." Robertson says: "Decomposition of nitro-glycerine with the removal of volatile products was studied between temperatures of 90° and 135° C. and obtained the following results":

"(1) In the apparatus used, the decomposition of nitro-glycerine proceeds in a manner as uniform as that of a stable gun cotton, when volatile products of decomposition are continuously removed.

"(2) The rate of decomposition is a function of the temperature, doubling for every five degree change between 95° and 135° C.

"(3) Nitro-glycerine has a higher rate of decomposition than gun cotton under similar conditions."

NOTE V.

The Hydrolysis of Nitro-cellulose and Nitro-glycerine. Oswald Silberrad, Ph. D., and Robt. Farmer, D. Sc., Ph. D., of the Royal Arsenal, Woolwich. From *London Chemical Society Journay-Transactions,* 1892-1906, page 1761. (Abstract.)

"Hydrolysis of Gelatinized Nitro-cellulose, etc.—Gelatinized nitro-cellulose differs so strongly from gun cotton in the compactness of its structure, that it appeared of importance to ascertain whether it underwent a similar hydrolysis in presence of

alkali. The course of the reaction was found to be quite analogous in the two forms of nitro-cellulose."

"In view of the wide application of gelatinized preparations, containing both nitro-cellulose and nitro-glycerine, an examination of their hydrolysis was of practical importance. Their behavior is somewhat interesting. It is known that nitro-glycerine volatilizes fairly readily from explosives containing it, and since experiment shows that this ester saponifies rapidly in alkaline solution, it is to be expected that the nitro-glycerine from such explosives will also undergo a similar hydrolysis. This is confirmed by experiments on cordite and ballistite. Both of these show a rapid hydrolysis in alkaline solution. An analysis of the residual cordite after hydrolysis shows that the hydrolysis is due almost entirely to nitro-glycerine which has passed from the explosive into the aqueous solution. Thus it was found that 70% of the nitro-glycerine in a cordite had undergone saponification, while the nitro-cellulose was almost unaltered."

"This throws considerable light on the mechanism of the changes which occur when cordites are subjected to prolonged storage, and the relative stability of cordite as compared with nitro-cellulose powder when stored in a damp atmosphere."

NOTE VI.

Treatise on Instability of Nitro-cellulose. M. Jacques, International Chemical Congress 1906 at Rome, (Abstract).

"The stability of nitro-cellulose depends on the main elements of climate, temperature, humidity, and method of stowing. It is influenced by (1) constitution of the nitro-cellulose (2) presence and quantities of impurities (3) treatment of the powder, care, etc.

"Even under the most favorable conditions there is a gradual retrogradation of stability,' which cannot be avoided.

"Causes of instability: 1. Nature of the nitro-cellulose. The instability of nitro-cellulose, or gun cotton, is most marked *at the limits of nitration.* What is sought in the French Powders is a mixture of stable form, stable *per se,* and stable in the mixture. Through the desirability of introducing high nitrated insoluble nitro-cellulose, this mixture is hard to obtain.

"Stability varies directly as contained moisture, and inversely as contained sulphuric acids, nitrogen, and as the temperature.

"In blending the powder the subsequent stability will be determined by (1) the state of the cellulose as to moisture (2) as to purity (3) means of mixing (4) density of mixture (5) temperature of operation (6) length of mixing process.

"Cause 2: Impurities—it is practicably impossible to drive out all impurities; there remain a few traces of nitrates, aldehydes, and organic acids, such as oxalic acid.

"Litmus tests usually show acid reaction due to minor impurities, rather than actual decomposition of the whole.

"Tests taken at any time are not good for any future time, as unsafe conditions may start serious reaction due to impurities.

"The best way to get rid of the impurities is by making the washing process in the manufacture most thorough, and doing it in an alcohol.

"Means of determining instability; tests:

"Heat and Litmus tests recommended. Heat tests show the condition of the powder as a whole; the Litmus test will show either that or presence of acid impurities. Heat test recommended is M. Sy's test of noting loss of weight of sample heated to 115° for 8 hours a day, or for quicker results, to 130-140°.

"The Litmus (including all paper tests, with iodide of zinc, diphenylamine, and chlorhydrate of metaphenlendiamine) tests may show either actual total decomposition, or slight decomposition due to traces of impurities.

"The author claims, therefore, that both tests should be made, the heat test to determine any latent instability in the whole mass, shown by excessive loss of weight due to volatile matters, the paper to show either that, or, in case the heat test is O. K. and paper test bad, the presence of impurities.

NOTE VII.

Note on the Stability of Poudre B. L. L'heure. Memorial des Poudre et Salpetres, XV, 1-38. Translation by C. G. Storm. (Abstract.)

"This note is a study of the behavior of Poudre B in sealed tubes, in various atmospheres, (air, nitrogen, carbonic acid) in some cases leaving the nitrous decomposition products in the atmosphere of the powder; in other cases absorbing them by means of a wad of silk or by diphenylurea (the researches of Vielle have shown that these substances easily fix the nitrous

compound). Temperatures of 110° and 75° have been used, as from results at these temperatures one can predict with considerable accuracy as to the stability at lower temperatures.

"Results of first and second series. These tests showed the superiority of sealed tubes over open ones from the consideration of stability, after heating at 110°, in cases where the tubes contained CO_2 or air with silk wool. It is seen that in the sealed tubes the stability at 110° decreases very slowly. The powder undergoes a slow decomposition, as indicated by the decrease in amount of N.

"Third Series.—The decomposition of the powder is only slightly reduced by absorption of the nitrous products, where open tubes are used.

"Fourth Series.—Results indicate advantage of heating in sealed tubes in air even without absorbents for NO, etc.

"Fifth Series.—These tests indicate the value of absorption of the nitrous products. (Closed tubes.)

"Sixth Series.—Several powders tested indicate that results obtained with several varieties of Poudre B agree with those obtained for Poudre B. F.

"Seventh Series.—Results show the advantage of sealed tubes and of absorption. (Tests at 75 with atmosphere of N and also of air with silk plug.)

"Eighth Series.—Results indicate that a sample of Poudre B. N. F. of poor stability is improved by heating in sealed tubes.

"Ninth Series.—1. Stability is not improved by replacing open tubes by one partly closed and containing an absorbent for NO_2.

"2. The superiority of sealed to open tubes is indicated, but results show that air, CO_2 and N give very little difference in stability.

"3. Powder heated in sealed tubes retains not only its chemical stability, but its ballistic properties as well.

"4. A gradual slow decomposition of the powder is indicated by loss of N and coloring of the silk.

"5. The pressure in the tube is always relatively low.

"Tenth Series.—Results similar to ninth series.

"Eleventh Series.—Tests made on large grain powders and confirmed the previous tests on fine powder, showing the superiority of sealed tubes compared to open tubes."

GENERAL RÉSUMÉ.

"The stability of powder at 110° and 75° is considerably increased by enclosing in sealed tubes, containing an inert atmosphere (air, N, or CO_2) and an absorbent for nitrous products (silk, for example).

"The tests show that prolonged heating at 75° (for as much as 80 days) does not appreciably affect its resistance to the ordinary 110° test. However, decomposition is not entirely arrested; the loss of N, loss of weight, reduction in velocity and, finally, the gradual darkening of color of the silk wool, show decomposition to be continuous, but very slow.

"At 110° the pressure in the tubes increases rapidly to the bursting point, amounting to several atmospheres; at 75° the pressure never exceeds 1 Kg., even after 80 days of heating.

"The absorption of nitrous products in the atmosphere of the open tubes or those partly closed, gives no appreciable benefits."

HYPOTHESIS.

"The fact that powder at high temperatures is better preserved in sealed than in open tubes, may be attributed partly to th fact of the pressure developed in the interior of the tubes during heating and partly to the fact that the solvent remains in the powder instead of being volatilized. We have attempted to determine the respective influence of each of these factors.

"1. Influence of pressure.—The results of several tests indicate that the effect of slight pressures is very small, when the solvent is eliminated; so that the the beneficial effect of heating in sealed tubes cannot be attributed to the pressure.

"2. Influence of solvent.—The process used consisted in heating the powder in open tubes in an atmosphere kept partly saturated by vapors of alcohol and ether, thus preventing loss of the solvent in the powder.

"The results showed clearly that the retention of the solvent in the tube is the chief cause of the benefit gained by heating the powder in sealed tubes.

"The presence of the solvent vapor in the atmosphere of the powder does not prevent nitrous decomposition, but, on the other hand, the gradual yellowing of the silk indicated progressive decomposition, as did also the constant decrease in N contents, and loss of weight of the powder.

"As the solvent does not retard dissociation of the nitro-cellulose, it is necessary to find the cause of its marked effect on stability.

"The following explanation is proposed.

"(a) Nitro-cellulose.

"The decomposition of nitro-cellulose (powdered) by heat is a simple phenomenon of dissociation, and the speed of evolution of nitrous products is constant at a given pressure and temperature, when the products diffuse freely into the air.

"For the nitro-cellulose agglomerated by compression, the phenomenon of dissociation is complicated by secondary reactions in the interior of the mass, the nitrous products of decomposition react on the nitro-cellulose molecules and increase the rate of decomposition. Thus, under mechanical compression, there remain inter-molecular spaces, sufficient for passage of the gas. These secondary reactions explain the low stability of nitro-cellulose made compact by pressure without gelatination. (Experiments of Vielle).

"(b) Colloids and Poudre B.

"In perfect colloids the agglomeration of the molecules is sufficient to reduce the inter-molecular spaces to a dimension less than that of the gas molecules, as a very thin membrane of collodion prevents diffusion of gas. Gaseous products cannot then form in the space between the molecules, and hence the effect is to limit molecular dissociation on heating to the surface which is in free contact with the atmosphere.

"But under the action of heat, the solvent molecules are eliminated, little by little, and spaces tend to form. After a certain time the colloid undergoes shrinkage, which may be sufficient to fill up these gaps. However, a point is reached where the shrinkage ceases and where the loss of solvent creates interior channels sufficient for passage of gas. The molecules of nitro-cellulose in contact with the channels may then be dissociated, and the nitrous dissociation products produce secondary reaction dangerous to the stability of the nitro-cellulose.

"On this hypothesis the stability of Poudre B is intimately connected with its degree of compactness, and the harmful effect of heating consists more in the destruction of its compactness by elimination of the solvent than in a direct decomposition of the nitro-cellulose.

"The ordinary 110° test gives a measure of the time necessary to produce a dangerous porosity in the powder.

"Heating in a sealed tube, preventing entirely the loss of solvent, alters very little the original stability of the powder.

"The principal action of stabilizing bodies (amyl-alcohol, Urea, diphenylamine, etc.) is to absorb nitrous products and reduce their formation in the interior of the powder, thus retarding the dangerous effects of porosity.

"Thus, the introduction into Poudre B of substances having an affinity for nitrous vapors considerably increases its stability, while the absorption of these nitrous products from the atmosphere of the powder has no beneficial effects, as noted in tests of series, 3, 9, and 10.

"The benefits gained at 75° having been as great as at 110°, it is almost certain that storage in completely sealed receptacles at ordinary temperature will increase stability at higher temperature.

"It does not appear impossible to realize a practical method of preservation comparable to that in sealed tubes, and we hope for the adoption of absolutely air-tight metallic cases for Poudre B and particularly for powders stored in hot magazines.

"The presence in the powder of a wad of silk wool for the absorption of nitrous products in the atmosphere of the metal case would also be of benefit."

NOTE VIII.

Inspection of Powder and Explosives for use of French War and Navy Departments.

As a result of the accident on board the *Liberté*, of the insistent demand of the Navy Department to inspect the manufacture of all powder intended for naval purposes, and of the recent investigation by the Chambre of Deputies of what has been termed in France the "Scandale des Poudres," the Ministers of War and Marine made a report to the President which has resulted in the following decree;

"The President of the French Republic,

"Acting upon the reports of the Ministers of War and of Marine,

"Considering that it is important that the department employing powder and explosives should be in a position to inspect the manner in which their orders for the same are executed,

"Decrees:

"Article 1.—That, for the purpose of enabling the War and Navy Departments to follow the manner in which their orders for powder and explosives are executed, inspection departments shall be established in all powder works.

"Article 2.—This inspection will be made under the direction of the Ministers of War and of Marine, each acting independently of the other.

"The personnel assigned to this duty will comprise:

"*For the War Department:*

Artillery officers of the Army.

Administrative officers of the Ordnance Department.

Subaltern officers.

"*For the Navy Department:*

Naval officers.

Naval ordnance engineers.

Administrative officers, non-commissioned officers and technical employees of the Navy and Naval Ordnance Department, and civilian employees of the Navy.

"The bureau of inspection for the War Department will be attached to the powder board of the War Department at Versailles and placed under the orders of the general, president of that board.

"The bureau of inspection for the Navy Department will be attached to the inspection department of manufactures of naval ordnance and placed under the orders of the inspector of manufactures.

"The bureau of inspection of each of these two ministerial departments will have a laboratory in which will be made the tests prescribed by the specifications, the tests defined by the regulations concerning the manufacture and the conditions of acceptance, and in general all experiments and tests concerning powder and explosives.

"The laboratory of the bureau of inspection of the Navy will be attached to the central laboratory of the Navy.

"Article 3.—Inspection will be made for the acceptance of raw materials, of the process of manufacture, and of the processes comprising either the constitution of the elements of the lots or of the lots themselves.

"Article 4.—The inspectors shall have access to all parts of the powder works, laboratories, and proving grounds, as well as to all storerooms containing raw materials, powder or explosives finished or in process of manufacture.

"The personnel directing the manufacturing establishments as well as the shop foreman will give the inspectors all information required concerning the details of manufacture.

"The inspectors will refrain from any interference in the processes of manufacture.

"Article 5.—The officers and employees of the Navy Department assigned to the inspection department of the manufacture of powder and explosives will be authorized, upon the request of the Minister of Marine, to pass periods of instruction in the 'Laboratoire Central des Poudres et Salpetres,' at the powder board at Versailles and in the establishments of the War Department charged with the execution of orders for powder and explosives for the Navy.

"Article 6.—Special orders from one or both departments, according to circumstances, will arrange details for the application of the present decree in the powder works coming under the authority of the War and Navy Departments, and, if necessary, in private works.

"Article 7.—The Ministers of War and of the Navy are respectively charged with the execution of the present decree, which will be inserted in the '*Bulletin des Lois.*'

"Paris, November 23, 1911."

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE VANDALIA'S FLAG.

By WILLIAM CHURCHILL,

Sometime Consul-General of the United States for Tonga and Samoa.

I find that I have kept no record of the transactions in the matter of the *Vandalia's* flag other than skeleton memoranda that I wrote a despatch urging the State Department to condemn it off my property return in Apia, and take it to Washington where the ravages of time would gnaw less quickly, and that some months later I had received instructions as requested and shipped the historic ensign. Details, it will be seen, are lacking, but they remain in my mind with sufficient accuracy.

Take up the story of the disaster where Louis Stevenson left it off in his "Footnote of History." I cite this because it is the most accessible account, the best story of those days and nights of gale was written by John P. Dunning, Associated Press correspondent, and published a month or six weeks after the event by the papers taking that service. It may be yet more convenient to take up the story at the end of my brief letter[1] when presenting to the Academy the autographed photographs of Seumanutafa and Fa'atulia, it would be a fit tribute that the flag and the pictures should find display together.

Sullenly the clouds drew back from the sea, the slope of Mount Vaea came into sight once more, a sight of ruin of a landscape once smiling. Upward and backward the heavy clouds slowly withdrew, men saw again after dreadful days the peak of Vaea, then slope after slope of the rearward mountain was revealed. At last the dull weight lifted from the Tuasivi at the summit of the

[1] UNITED STATES NAVAL INSTITUTE PROCEEDINGS, xxxiv, 601.

mountain crest, to windward the sharp ridges of Letongo Mountain were once more visible, to the leeward the eye found again the flat table top of Tofua.

The wind was stilled. That wind, the source of all the evil that had been wrought; *afflavit Deus et dissipati sunt,* the Armada motto, yet ours was an Armada trapped helpless in Apia, *Trenton, Vandalia, Nipsic,* wood they were and they were snarling with steel, yet they would have fought man for man had not wind set on a battle gage which neither foe nor friend could decline, a hopeless contest of man against an onshore gale and the biting reef within the tossing of a biscuit. The sea alone was in turmoil when the breeze went down and the nimbus of the storm went upward. You cannot imagine the sea within the Apia reef, it fights and worries for days after the gales have passed; the Vaisingano, pleasantly named the river of the fragrant pandanus blooms, pours torrents over its bar of coral chips; the currents swirl between the reef groves, gnawing, rending, tearing. Fine bones there were to pick in Apia harbor.

Close to the Vaisingano mouth and a little to the westward lay the *Olga* and the *Eber* stranded and torn; a little farther to the west and on a coral shelf, to which local taste has given the name Cape Horn, lay the *Adler,* tossed high out of water, her keel barely awash at high water full and change; there she lies to-day blushing with rust at such unwonted ship burial, riven is her hull, corkscrewed in the pleasant air. East of Vaisingano on the coral stretch which extends northward to form Matautu Point lay the *Trenton,* dead, lay the *Vandalia,* dead; two dead ships, but even dead they were not disgraced. Higher up the point lay the *Nipsic,* stranded, sorely wounded, but still alive. How she got in safety to that beach no man ever knew. She writhed like a cat in and out among corals which should have torn her bottom out, what she could not dodge she rammed and broke a miracle way through. Ten years afterward when on formal visits to receive the quota of nine guns speaking the peaceful salutation, the shortest way for my gig was through a lane gouged athwart two reefs, the path which the *Nipsic* had pioneered, scarcely in a century may the madrepores repair what this sole surviving ship did to their walls and bulwarks.

Kimberly, on the beach—no admiral was ever disgraced by striking his flag to the elements in their fury—intent upon the first

duty of all captains courageous, was caring for his men whom the sea had spared. There were survivors to be housed; what became of Seumanutafa's Samoans it is hard to say, for every roof that had escaped the gale protected more than its complement of the rescued. There were survivors to be fed, and the fury of the hurricane had spared the land no more than the sea; rations were a crying problem in a scarcely civilized community where to-day's feast means to-morrow's famine. There were the dead to bury. Every day saw the firing parties winding up the Ifiifi road to a little hillock where grave after grave lengthened the orderly line of burial quarters, there to lie still until the last draft came to carry the crews home to Mare Island.

If food was hard to come at in these first days on the beach drink was put still further out of reach. Here enters Blacklock. You will find Blacklock threading through this narrative, William Blacklock, Vice Consul-General of the United States, by long odds the finest figure that the motley show of Samoa has ever presented. I had cause to regret that I yielded to high representations and neglected to continue him in office; one of the pleasantest recollections of my tour of duty is that at the end I was able to renominate him to the post. It was Blacklock, when the gale was at its worst, who went through the wickedness of waterside Apia and closed the bars; just what his authority might have been no one really ever knew, but a moral force in time of need is superior to ordinances of aldermen and such like foolish officialdom.

Those processions to Ifiifi, and they were spread along many days as the sea reluctant yielded its prey, were not the only funerals. There were dead in the narrow harbor, dead ships to bury and no ritual in any prayer book for such solemnity. It is easy for the disciplined mind to contemplate the death of a ship in her own element, no one but can feel the thrill when the trooper *Birkenhead* makes her last plunge and the gale pauses abashed at the rattle of accouterments and the soft thud of pieces when aligned on decks already awash platoons present arms to their only conqueror. But what to do with ship corpses on the shore? The dead ships were a danger to the living, twice a day the tides washed out of their bowels that which was a menace to the community. Dead ships caught fast in the coral of a treacherous shore cannot bury their dead. Help must come from somewhere.

Again Blacklock. I have said that he was Vice Consul-General. More than that, he was acting in the place of his absent chief. There were regulations, the navy had its set of regulations, the State Department had its volume of regulations, Blacklock was doubly bound. But coils of the reddest tape could not hold such a man. What could not be done by him in the coils of regulation could be done by a corporation. There sprang into being the Trenton and Vandalia Wrecking Company, its first duty to preserve the little town from the pestilence breeding to windward. It was all Blacklock working for good, sometimes a little difficult to know whether it was Blacklock in official position, or the company, working hotly in the burial of the dead ships. But the work was done, the ships were torn to pieces and the menace was lifted from the town.

It is pleasant to recall the courtesies paid the *Calliope* as she inched her way through the bottle neck of the barrier reefs and at long last won out to the safety of the open sea. Ready to die the *Trenton* lay in that passage steaming to her anchors and dragging, her death the only thing that could give the *Calliope* the chance to be free. Yet as the *Calliope* went by full honors were given and returned, *ave, Caesar, morituri,* as gentlemen and gentle ships should do. When we see the executives keeping their manners in the article of death it does not surprise us that the fleet fought through its supreme engagement with colors flying, there is a dress of death and these ships wore it.

After the havoc had all been wrought there rose above the water the ensign of the *Vandalia,* sodden with the weight of rain in its four fathoms of breadth, far too heavy to be rippled by the milder breezes, hanging in mourning over the wreck and death below. It was Carlin's duty to strike the flag when all was over, once ensign now wreck stuff and mere salvage. In time of such disaster men know men, Carlin gave the flag to Blacklock, a fitting disposition. Modest above all things Blacklock would not accept it for himself, it was to him something too fine for any Trenton and Vandalia Wrecking Company then coming into being out of the nation's loss. He inscribed it on the property return of the consulate and gave it the noble space on the wall, in time he decorated its place of honor with rusted cutlasses and coral-clogged firearms, to which in my own time and in recognition of the same fetichism I added weighter decoration of shells from the *Trenton's* magazine.

There it hung for ten years. I knew it would leave an emptiness and a void when I shipped it home to custody where it would ever be a green memory. What else could I do? There was the mildew to fear in an unequal fight. There were ravaging insects at work upon the bunting. Once I had a reverend visitor, his title left me incautious, only just in the nick of time did I hold back his pocket knife from the star which he sought to excise from the field of thirty-eight. I am glad that this flag which the *Vandalia* wore to her death will find its proper home in loving keeping where new sailor generations are bred. It is a record of disaster, it is the flag of a surrender, but we are proud of its reminder that in all history only one foe has ever seen the flags of an American squadron come down, that foe the brute violence of the angry heavens.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

WHAT'S THE MATTER WITH THE NAVAL ACADEMY?

A PLEA FOR A FIVE YEAR COURSE.

By LIEUT.-COMMANDER A. W. HINDS, U. S. Navy.

There is probably no school in the country with a better reputation for thoroughness than the U. S. Naval Academy; and there are many reasons why the Academy should have this fair reputation. The instructors are conscientious—both the civilians and the naval officers. The sections consisting of from 9 to 12 midshipmen are small enough, ordinarily, to allow for individual instruction in addition to the assignment of marks for gradation. Compared to other schools the sections here are only about one third as large.

The arrangements for the midshipmen are almost ideal. The quarters are comfortable; the food is good; the study and exercise hours are remarkably well balanced; during study hours there is no interference by room to room visiting; there is not the slightest ground for the criticism of the late Mr. Crane on all college courses, *i. e.*, that a large percentage of college undergraduates spend their time getting drunk.

It would be a difficult matter to suggest any method of teaching better than the one that has been used here, with success, for many years. Lessons are assigned and the midshipmen dig them out for themselves. Day after day they recite on these lessons—tell what they have learned about them and receive a mark for the day's work. This gives them confidence and teaches them to rely on their own efforts. At the end of a month an examination brings out what the midshipman have retained of the month's work and the semi-annual and annual examinations show whether they have kept in their minds the general principles covered during the term's work. The system of teaching used at the Naval

Academy is used by very few other schools in the country—in fact West Point is probably the only other school using it. The reason of this is that at the other instituions of learning the sections are too large and the instructors too few to allow much individual instruction or to allow for individual recitations. The number of instructors provided for the school is of course a function of the money provided for running expenses; the number here is, ordinarily, sufficient for the needs of the school. Where there are 25 or 30 students in a section the only feasible way to cover the subject matter is to have lectures, *i. e.*, have the instructor do the reciting, and find, from examinations, what the students have learned. There are two main objections to the to the lecture system. (1) There is a certain amount of inattention even at the most interesting lecture; at some time during the talk the thread will be lost, and, even though this may be momentarily, the value of the lecture will be decreased by reason of such loss. (2) It is a bad policy to work out the difficult problems for a student; he will remember much longer if he is compelled to work out everything for himself. **It is very probable that if the other schools of the country had enough instructors to keep the sections small they would use the same system of teaching used at the Naval Academy.**

CRITICISM CREEPING IN.

Notwithstanding the fact that the methods of teaching used here are good, and that the midshipmen probably use more of the four years at the Naval Academy to advantage, on an average, than is used in other schools, criticism of the Academy and its graduates are creeping in—from the fleet and from other sources. A straw vote taken here would show that the majority of the instructors and heads of departments think that in preparing them for their life work we are not giving the midshipmen the best course we could give them.

The main trouble with our course as it now stands is that it is **one year too short.** Twenty-five years ago the principal studies at the Naval Academy were mathematics, English, physics and chemistry, seamanship, navigation, and modern languages. Marine engineering and ordnance required only a fraction of the time they now require.

At that time the course was well covered, for there was great competition for the comparatively few commissions issued to each class. The time taken to graduate was the same as it is now—four years. During the twenty-five years some of the studies like mathematics, navigation, physics and chemistry, English, and modern languages have changed very little. Other studies like marine and electrical engineering and ordnance and gunnery have changed greatly. The changes in the last named have all been **additive.** It seems fair to say that all three have doubled in the amount the midshipmen have to learn in order to thoroughly understand the subject; and yet, with the entrance requirements very close to what they were then we are trying to cram all this **additional** learning into the heads of the midshipmen in the same length of time as was taken twenty-five years ago.

A comparison of the number of two hour periods spent on each subject in 1889-1900 and 1911-1912 is interesting.

Year	Mathematics	Mechanical drawing	English	Languages	Seamanship	Navigation	Physics and chemistry	Electrical Eng.	Marine engineering and naval construction	Ordnance and gunnery
1889-1900	496	208	208	224	64	176	140	110	304	96
1911-1912	442	112	192	224	128	176	96	192	320	160

This table shows that mathematics has lost 54 periods, physics and chemistry 44 periods, and mechanical drawing 96 periods during the past ten years.

The loss in mathematics is the one that does the heaviest damage; it hurts the courses in physics and chemistry, in navigation, in ordnance and gunnery, and in marine and electrical engineering—practically all other subjects. On account of lack of time and lack of practice in mathematics, the students, at the present time, take up new subjects poorly equipped. They cannot perform the ordinary operations of algebra and trigonometry rapidly and accurately, and instead of spending their time and energy on new work they have to spend it in reviewing mathematics in order to apply it intelligently to the allied subject.

The loss in physics and chemistry is also a drawback. From a study of the courses at West Point, and at other schools, it ap-

pears that they spend much more time on these subjects than is spent at the Naval Academy. A knowledge of both physics and chemistry is needed in a successful naval career. We are constantly called on to use the general principles learned from them. A knowledge of chemistry is absolutely essential in the engineering of the present day. A midshipman must have a reasonable understanding of the science of physics before he can successfully take up the study of marine and electrical engineering. Laboratory measurements, experiments and demonstrations as well as recitations are necessary. The Naval Academy has excellently equipped chemical and physical laboratories, but insufficient time is allowed for their use. No college or scientific school expects a student to acquire a working knowledge of these subjects in less than three times the number of periods allotted to the study of physics and chemistry at the Naval Academy. The study of sound, light and heat is closely allied to that of mathematics; it requires the midshipmen to think and, after all, the practice of reasoning is one of the best features of the Naval Academy education.

If enough time were given to mathematics to get it thoroughly ground in so the midshipmen could apply it successfully to the allied subjects, the time allotted to marine engineering and to navigation would be sufficient as it stands. This does not take account of the loss of time in mechanical drawing which is one of the branches of marine engineering; 112 periods is not enough; 160 periods would be nearer the necessary time. Incidentally, there is good authority that the army and outside concerns are glad to get our graduates because they are good in mechanical drawing. A blue print of a piece of machinery is not an enigma to them. This will not hold true when we begin to graduate the midshipmen with only 112 periods spent on mechanical drawing.

In addition to more time devoted to mathematics, and to physics and chemistry, more should be given to electrical engineering and to ordnance and gunnery.

It is pretty generally admitted that naval officers in our service are weak in electrical engineering. There are too many things on board ship that depend on electrical gear to allow this condition to exist. Lighting the ship, its ventilation, working the turrets and guns, supplying ammunition, interior communication, fire control, in fact the whole efficiency of the ship as a fighting

machine is so vitally affected by the efficiency of the electrical installation that we cannot afford to graduate midshipmen and leave them in an admittedly weak condition as far as electrical knowledge is concerned.

Ordnance and gunnery is in the same plight—there is simply not enough time to cover the subject properly. The head of the department states that it would require one-third more time than is now assigned to that department in order to send the midshipmen away from here well qualified.

COMPARISON WITH OTHER SCHOOLS.

During the past four or five months the writer has obtained data from many of the leading colleges of the country. While the information was very full, it is rather hard to compare these institutions with the Naval Academy on account of the different methods of teaching and marking. In making the comparisons engineering courses were selected as they bring in mathematics and engineering, and it was thought that allowance could be made for the additional subjects taken at the Naval Academy, subjects which are strictly professional and which are not taken at other schools. While we did not get everything sought for from the information sheets from these colleges, the following facts were established beyond question: (1) The entrance requirements are higher at all the colleges heard from than at the Naval Academy. (2) The mathematics at the academy is about the same as that of the other colleges. (3) The courses in engineering are about equally difficult. (4) Not one of the colleges has a course shorter than four years. (5) Two of the colleges; although having more rigid entrance requirements than the Naval Academy, do not graduate their students in engineering in less than 5 years. (6) Ten of the eighteen used for comparison have additional courses of from one to three years in engineering—this means after the preliminary four years of work.

We have at the Naval Academy the brothers of these college men. The average brain power here ought to equal that at the colleges. How then can we cover **thoroughly** the same ground in four years that they cover in an average of more than four years if the college students are better informed when entering college.

But we do **not cover the same ground—we cover much more.** The mathematics and engineering are about the same. The Eng-

lish and physics and chemistry are perhaps a little easier than in the engineering courses at other schools. But many things are covered here that engineering courses in colleges never touch, as for instance—navigation, astronomy, modern languages, seamanship, international law, ordnance and gunnery. How can we ever cover this extra work in less time than the other schools take when their men are better prepared at entrance. There is at hand a letter from a Naval Academy graduate so apropos that I must quote an extract from it: "I am a graduate of the U. S. Naval Academy, retired, and have been teaching twenty-five years. There is no doubt that your course should be one of five years for the best results to the student. Time is required to do good work anywhere. To teach students fundamental principles so that they cannot forget them even if they try; to teach students to do things, to originate, instead of copying, requires time."

LACK OF COMPETITION.

Competition at the Naval Academy was killed ten years ago with the advent of the big classes. It seems unnecessary to call attention to the value of competition. The wonderful improvement in gunnery and in engineering in the navy are examples of the result of competition. In the days when the commissions per class were but few, there was a scramble for them and the best man got them. The commissions were the reward of hard work and well cultivated intellect, and the graduates who got them were the thinkers of the class.

With the large classes came the need of a greater number of officers. We had to have them to man the ships. The midshipmen knew this and studied less. The marks went up; 2.5's gave way to 3.0's, for they all had to be graduated.

All this resulted in what was near kin to a union. The midshipmen realized that if the bright ones studied hard the ones who were "wooden" could not get through. It became bad form to "study out of study hours," and why not? It is against human nature to do more than one needs to do. The plane of marks was necessarily shoved up in order to supply our own needs, and, once up, it became difficult to lower. It is not my desire to go on record that these men will not make good officers. I trust they will, I believe they will if they work hard. This much, however, is certain; they must cultivate out in the service the thinking

power that they should have more nearly perfected while at the Academy.

Next year, unless the laws are changed, the large classes will cease to exist. This will be a bad thing for the Academy and for the service at large. The classes should be kept as large as they are now, but only the number needed to fill the vacancies should be commissioned. This would give a lot of education at the expense of the government, but the money would be well spent. Furthermore, the students who spend 5 years at the Academy, even though not commissioned in the navy at graduation, would be of great value in war time.

The Bureau of Navigation could decide how many are needed each year. Out of an entering class of say 300 there might be 100 or 120 to commission, and competition, one of the most powerful incentives ever used at the Naval Academy, or anywhere else, would help work out the Naval Academy problem.

AGE OF ENTERING.

The age of admission and the entrance requirements should be low for many reasons, among which are: 1. Algebra and geometry form the foundation of all mathematics; if those two subjects were taught here we could be sure the midshipmen have the proper foundation to build on. 2. The Naval Academy would get a more ambitious set of boys. Suppose, for instance, the lower age limit to be 18 years; most boys of that age who are ambitious have decided what they are going to do in life, and, even at 17 many of them have started the education that is to fit them for their life work. 3. The younger the midshipmen are the more impressionable they are and the easier it is for them to drop into the "Customs of the Service." 4. If taken, say on an average of two years younger, they could put in the additional year required for a proper education and still become commissioned officers two years and a half younger than they do now. The age of entrance is now 16 to 20, a mean of 18 years; add 6 years for the present course (cunting the two years at sea) and the average age for commissioning is 24 years. The Smith Bill makes the entering age 15 to 18, a mean of 16.5 years, add to this the 5 years which are need here and there results an age for commissioning 21.5 years, which is two and a half years less than the present age when commissioned.

SUMMING UP.

A five year course would give sufficient time in mathematics to properly fit the midshipmen for studying the other subjects taught here; it would give sufficient time in physics and chemistry, in ordnance and gunnery and in electrical engineering. It would give a total time of one year on summer cruises, which ought to furnish enough sea experience to justify a commission on graduation.

And if the congressmen and senators are allowed, after 1913, the same number of appointments they now have the percentage of commissions issued to a class at the end of 5 years would be small enough to keep alive the keenest kind of competition.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

CRUISING IN FORMATION.*

Translated by COMMANDER R. R. BELKNAP, U. S. Navy.

A. STATION KEEPING.

Good station keeping is an indispensable fundamental condition for good and safe steaming in formation. This should be perfectly clear to every watch officer, and as a result of this knowledge every one of them should have the energetic determination to be always properly in position, and to improve continually in his manner of attaining this end.

A general principle is that an officer will steam better the fewer engine signals (*i. e.*, changes of speed or of the engine revolutions) he needs for keeping station. Beginners generally steam in a way much too unsettled. They are often too rash with engine signals, and still they do not keep in place. The reason in most cases is that they do not sufficiently take into account the inertia of the ship. They believe that any change in the speed of the engines should appear at once, forgetting that the ship always needs some time in which to take up the speed corresponding to the number of revolutions, both in case of increase of speed and of reduction. In forging up in column, for instance, they will wait too long before ordering the prescribed speed, as a result, shooting ahead by the excess momentum of the ship; then will considerably decrease the speed, and presently fall behind again by not increasing the speed again in time; and then when steaming up will again run too far ahead. Such unsettled procedure, by which the ship never becomes steady, is in the first place a cause

*Translation of a chapter on "Wrinkles for the Watch Officer" in the work on "Seamanship," by Vice-Admiral Dick, I. G. N., which is approved by the German Admiralty as a text book for use in their navy.

Certain references in the original applying only to triple-screw ships have been omitted in the translation.

of much strain on the engineer personnel, and it also makes a needless consumption of fuel. Finally, it will in most cases be communicated to the rear in increased ratio, and is liable to unsteady the entire formation.

For further details in this regard, see under (a) below. In cruising (*i. e.*, outside of evolutions or special manœuvers), it is generally correct to use, not changes of rate of speed, but only changes of the number of revolutions; because the guide ship is steaming at a steady speed, and consequently there is no reason at all for any great change of speed, if sufficient attention is paid. In evolutions, on the other hand, this means will not be sufficient, on account of the rapidly changing situations, and because any mistakes in regard to distance and bearing must always be rectified as quickly as possible. It will very often be necessary to work with changes of the rate of speed (*i. e.*, from standard to half, or standard to full speed, etc.). Nevertheless, in performing evolutions, one should be as sparing as possible with orders. When one begins energetically to educate one's self in this, marked progress will soon appear. In general, the following maxims may be established for the guidance of the watch officer when steaming in formation:

1. Keep in station.
2. Manage with the fewest possible engine signals.
3. When cruising (*i. e.*, not manœuvering), work only with small changes of revolutions.
4. In evolutions, use changes of rate of speed as may be necessary.

Good steering is, of course, of the first importance for good station keeping, as well as for good navigation in general. The watch officer must use great circumspection in choosing his helmsmen, and spare no pains in training them. When doing evolutions, the best helmsmen should always be at the wheel, because then good steering is of especial importance.

(a) *In Column.*—On the jackstaff, at suitable height, an iron crossbar must be fixed, which, according to the height of the eye of the watch officer, cuts at a certain point on the stern of the next ahead (as, for instance, lower edge of stern anchor), when the ship is accurately in station. In good weather, by close attention even a small shifting of this mark up or down can at once be detected, and thereby any forging ahead or dropping

REVOLUTIONS.
30

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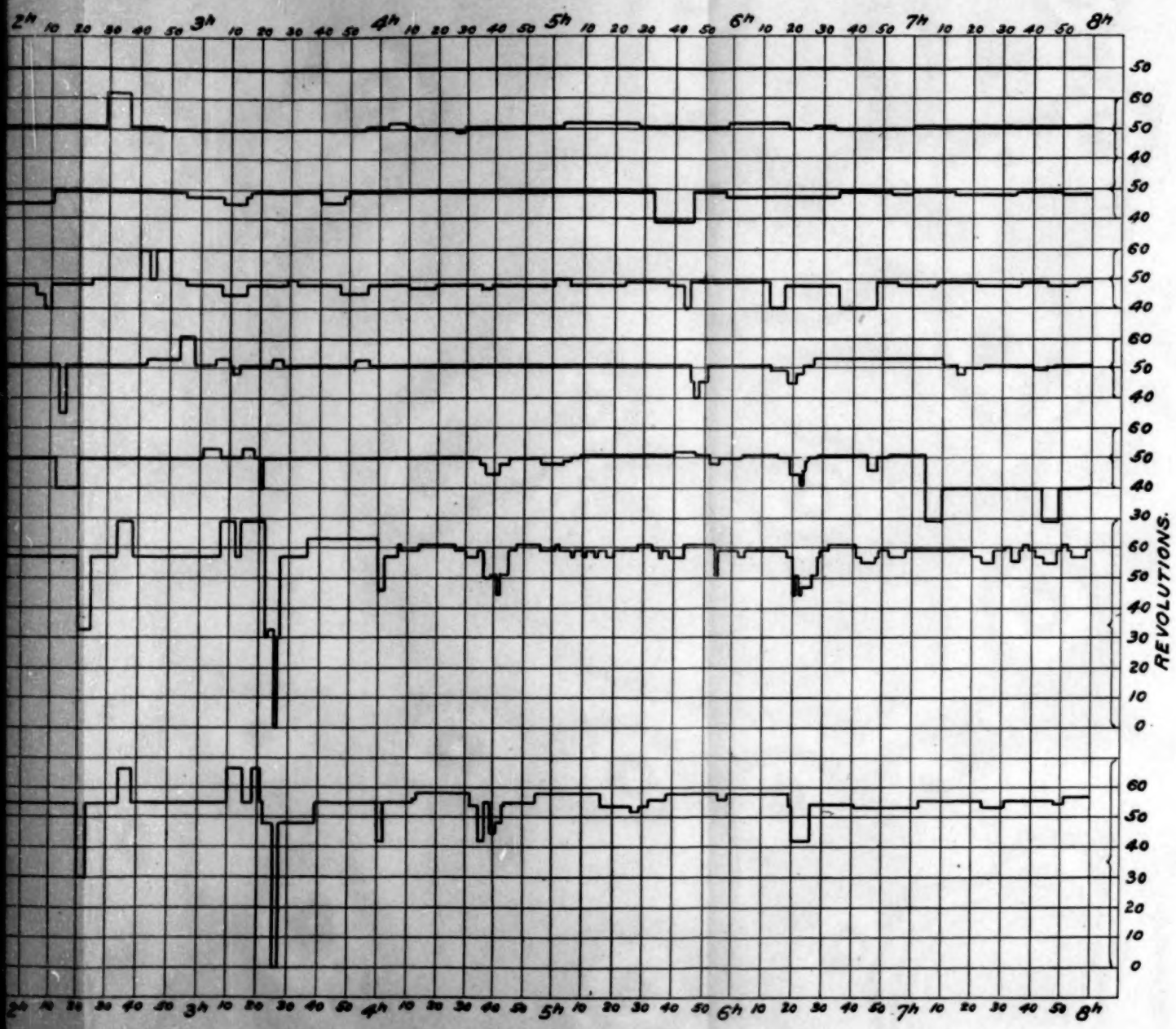
Good steering is, of course, of the first importance for good station keeping, as well as for good navigation in general. The watch officer must use great circumspection in choosing his helmsmen, and spare no pains in training them. When doing evolutions, the best helmsmen should always be at the wheel, because then good steering is of especial importance.

(a) *In Column.*—On the jackstaff, at suitable height, an iron crossbar must be fixed, which, according to the height of the eye of the watch officer, cuts at a certain point on the stern of the next ahead (as, for instance, lower edge of stern anchor), when the ship is accurately in station. In good weather, by close attention even a small shifting of this mark up or down can at once be detected, and thereby any forging ahead or dropping

FIGURE 1. TABULATION OF THE CHANGES OF SPEED WHILE CRUISING AT 9 K

TIME
8h 10 20 30 40 50 9h 10 20 30 40 50 10h 10 20 30 40 50 11h 10 20 30 40 50 12h 10 20 30 40 50 1h 10 20 30 40 50 2h
REVOLUTIONS.
No 1
Average 50
No 2
Average 50 Maximum 62 Minimum 49
No 3
Average 48 Maximum 51 Minimum 33
No 4
Average 48 Maximum 60 Minimum 40
No 5
Average 50 Maximum 61 Minimum 29
No 6
Average 50 Maximum 57 Minimum 29
No 7
Average 57 Maximum 69 Minimum 30
No 8
Average 54 Maximum 67 Minimum 30 Twice stopped.
No. 7 and 8 belong to a different class of ships
TIME

AT 9 KNOTS MAY 4, 8 P.M. TO MAY 5, 8 A.M.



back. One may also very soon be able to see about what distance one is ahead or astern of station when the crossbar cuts at a certain distance above or below the point where it should properly cut. Consequently, while cruising in favorable conditions of weather, one can in general entirely dispense with a sextant. In any case, the officer who has the watch should try to make himself as independent as possible in this regard, by constantly training his eye. In carrying out evolutions, on the other hand, two sextants must always be at hand. Remember that the above mentioned mark will vary with increased consumption of coal, and therefore that one must verify it anew every day.

For the night, an electric light shining very faintly must be arranged on the jackstaff accurately at the height of the crossbar, and the watch officer must know how this light is to be held in regard to the next ahead's lantern.

As also, very often, steaming is done at 400 meters * distance (for instance, before anchoring in a roadstead with a tideway), it is well to arrange, over the above mentioned crossbar, another smaller one, for steaming at 400 meters. For those occasions when the jackstaff is to be removed (clearing for action) a wooden substitute staff must be prepared, provided with a proper mark at equal height.

Steady and uniform steaming is a preliminary condition for good cruising in column. The leading ship must accurately hold the speed ordered, and every ship astern of her must carefully endeavor to vary as little as possible from that speed. Any great change is communicated generally in an increased ratio to the ship astern, and therefore, although the guide be steaming uniformly with standard speed, the presence of only one unsteady ship near the head or middle part of a long column may result in forcing the ships at the rear of the column to vary from full speed to slow or steerage way. Even stopping or backing has been observed in such cases. Figure 1 shows an instructive example of this. It gives a graphical representation of the changes of speed, according to the engine-room logs, of the ships of a squadron not yet trained, during a twelve hours' night cruise. Such conditions are, of course, extremely uncomfortable and prejudicial, both on the cruise and in the fighting line. They can only be avoided, however, when every watch officer fully appreciates the cause and with

* Usual distance was 300 meters when this was written.

painstaking attention endeavors to steam steadily. For this, it is absolutely necessary to pay close attention continually to the speed signals of the ships ahead and to the behavior of the above mentioned mark on the jackstaff. Avoid also the frequently occurring fault of taking up too late a new increase of speed ordered, because of being rather too near the next ahead and wishing first to settle back somewhat. In such circumstances, if one waits until the mark on the jackstaff visibly shifts, one will generally fall much behind and will have to recover from this error by correspondingly increasing the speed. But such compensating costs time and coal.

Good attention to one's own speed signals and night indicators is also of importance. Have the man on station correctly instructed in these operations and have him always report, on change of speed, that the cones stand properly, or that the night speed indicator is properly operated. The next astern will feel grateful for the pains taken in this regard.

Uniform cruising of a trained squadron must be demanded under all circumstances, both for the cruise and for the line of battle. During a cruise, for instance, in a four hours' watch, for all the ships astern of the guide, only a small number of engine signals (for instance, a maximum of 10) under normal conditions should be given, and all the signals must require only slight changes of revolutions. Notwithstanding these, however, the ships must keep in station steadily. A good means for educating watch officers in this respect is for the commanding officer to have the watch engineer tabulate the engine signals given during the night, by watches, and then make these known to the officers concerned.

When cruising with screened lights and in fog, quiet and steadiness in the column are of especial importance. In fog, in the first place, a certain unrest is likely to make itself felt because some ship, not properly in station, seeks to get connection with the ship ahead and afterwards is compelled to reduce speed below the normal, in order not to come too close. In such case one must strive energetically to re-establish steadiness in the column as soon as possible. Steady cruising in fog is by no means difficult, if no great changes of course become necessary, nor any turning out for passing ships. Keep the fog-buoy of the ship ahead

between the bow and the fore bridge.* Of great importance is good operating of the search-lights. The stations to be taken and the duty to be carried out in fog must be regularly assigned by station bill for each division (electrician watch) and carried out without delay on the command "fog" (to be given also to the engine-room, under which come the electricians).

If, for instance, by one's own insufficient attention or by faulty handling of the speed signals of the ship ahead, you should get so close to the latter that danger of collision will arise, you must sheer out and reduce speed. But do not sheer out more than necessary, and return into the column as soon as possible. In a trained squadron, the necessity for sheering out should not in general occur.

(b) *In Line Abreast.*—Besides the proper distance, the proper bearing must also be kept. For keeping the proper distance, good course steering by all the ships (especially, of course, by the guide) is very important. Corrections of distance, when on correct bearing, are made by slight changes of course (in general ⅛ to ½ point is sufficient). One then steams over a somewhat longer course than the guide ship does, and therefore must increase the speed a little, in order to remain on the right bearing. Any changes of course of ½ point or more, it is best to communicate to the ship next away from the guide, by flag semaphore, in order to facilitate his keeping of distance.

The bearing must continually be verified on the alidade, and, if necessary, be at once corrected by increasing or reducing the speed. If both distance and bearing have to be rectified, one has mainly only to increase speed, if behind, or to decrease it or maintain it (according to the amount that the course is changed at the same time), if too far ahead.

Although by change of speed the other ships are not influenced, one must nevertheless endeavor to steam as quietly and steadily when in line abreast as when in column. To do so, it is necessary to act at once, as soon as you perceive any changing on the alidade. Especially beware of standing too far ahead. Also remember that the sight line of the alidade must be correspondingly shifted when making any change of course, and that a correct bearing can only be taken when the ship, for the moment, heads exactly on her course. Therefore, have it reported to you each

* 10 yards ahead of the stem with us.

time from the steering compass when the ship is accurately on, and use these moments for verifying the bearing.

(c) *In Line of Bearing.*—Steaming in line of bearing is generally found very difficult by the beginner; but as a matter of fact it is scarcely more difficult than steaming in line abreast, when one has fully grasped the nature of the line of bearing formation.

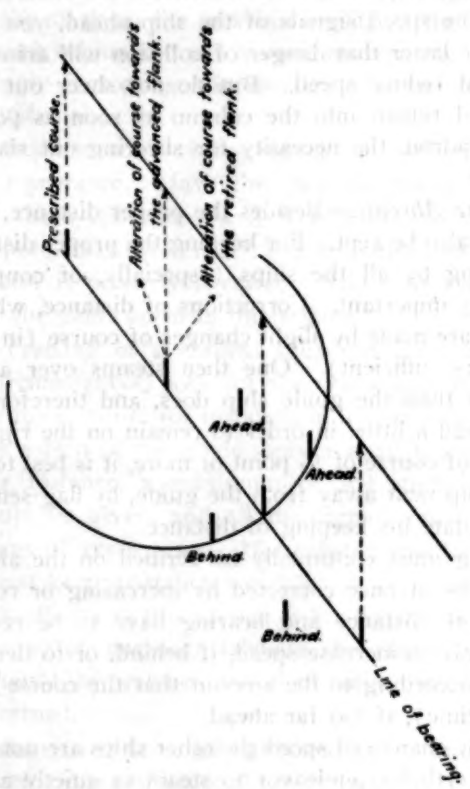


Figure 2

Changes of distance, when on correct bearing, are obtained by altering course by a certain amount (⅛, ¼, ½ point) and altering speed; but this change of speed, in contrast to the practice in line ahead, is either an increase or a decrease, according as the change of course is made towards the advanced or towards the retired flank. If the speed ordered be maintained unchanged,

then if a change of course be made towards the retired flank—which is the same as towards the normal to the line of bearing—the ship would forge ahead too fast; while by a change towards the other flank, she would fall back. This can be clearly seen from Figure 2. This must be clearly kept in mind when cruising in line of bearing. Of especial importance in any change of course towards the retired flank is the immediate reduction of speed, because otherwise one will very quickly get

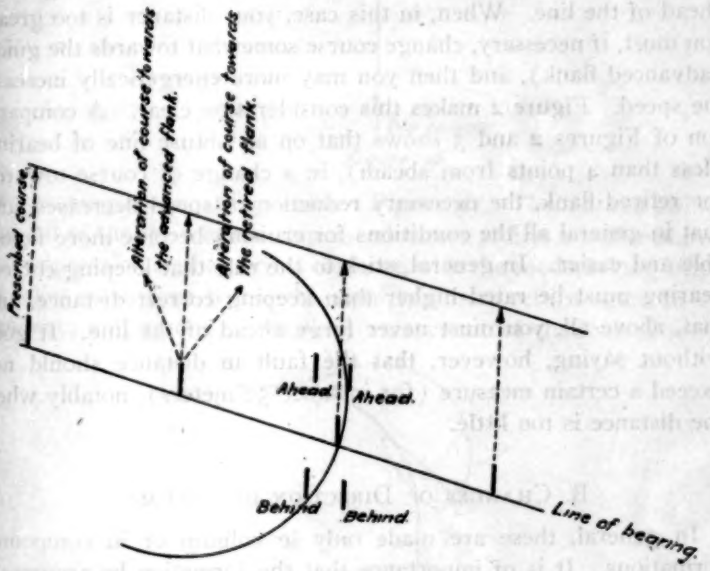


Figure 3

ahead of the line, which must be avoided absolutely. Small changes of revolutions are generally not sufficient in such a case; even in changing course by only ¼ point, one will, as a rule, be compelled to take a lower rate of speed.

In case one is too far ahead, yet at the correct or too great a distance, if one attempts to correct the bearing by only reducing the speed, one will make the distance too great. One must therefore at the same time make a change of course towards the advanced flank, paying sharp attention to the bearing, in order that the normal speed, in connection with the quick dropping back, may be resumed in time. If, when ahead of the line, you have

much too little distance, so that during the settling back you must at the same time head away somewhat from the guideship's course, a quick regaining of the correct bearing is possible only by a considerable reduction of speed, because of the conditions discussed above. If, on the other hand, you are too far astern and have the correct or too little distance, then by merely forging ahead up to the line of bearing you will get too close or still closer. You must therefore at the same time head off a little, and be careful with the increase of speed, in order to avoid getting ahead of the line. When, in this case, your distance is too great, you must, if necessary, change course somewhat towards the guide (advanced flank), and then you may more energetically increase the speed. Figure 2 makes this consideration clear. A comparison of Figures 2 and 3 shows that on an obtuse line of bearing (less than 4 points from abeam), in a change of course towards the retired flank, the necessary reduction of speed decreases, and that in general all the conditions for cruising become more favorable and easier. In general, stick to the rule that keeping correct bearing must be rated higher than keeping correct distance, and that, above all, you must never forge ahead of the line. It goes without saying, however, that the fault in distance should not exceed a certain measure (for instance 50 meters), notably when the distance is too little.

B. CHANGES OF DIRECTION OF COLUMN.

In general, these are made only in column or in compound formations. It is of importance that the formation be accurately maintained; hence, that each ship, immediately after having completed the turn of the number of points ordered, will see the masts of her file leaders in line and be at the proper distance. To this end she must turn in the same water and on the same arc as the leading ship does. An ugly fault frequently occurring, notably with beginners, is that the turn is made too late, so that, even by the use of the full helm angle available, it is in most cases no longer possible to avoid going outside the arc of turning of the guide ship. In such a case, since it is necessary in connection with the turn to get back again into the column, a more or less large arc is formed at the turning point (Figure 4), which quite appreciably impedes the turning of the ships following, looks very bad, and besides, on account of the longer track and the larger angle to be made, makes the line unsteady and breaks it up.

Very often the further fault is added, that, because the stern of the turning ship ahead deviates from the tangent, the course is not accurately kept, but her stern is followed outwards. The tendency to sag away is thereby substantially increased and cor-

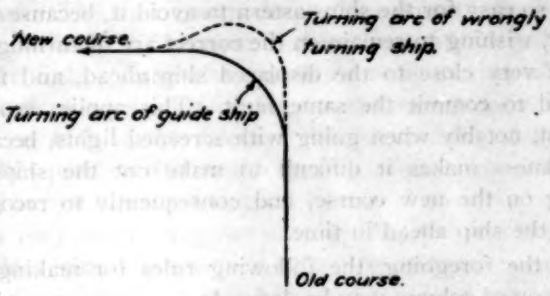


Figure 4.

rect turning is almost impossible (Figure 5). The marked swinging out of the stern of the ship ahead makes at first a rather alarming impression at the normal distance with the modern long ships. It takes some time before the stern begins to return again to the tangent; and as one's own ship, on account of the loss of speed

Figure 5.

of the ship ahead, will at first run up on her, a beginner is likely to think that there is danger of collision. In reality such is by no means the case, if one's own ship is properly in station; the ship, it is true, will approach rather near to the stern of the ship ahead,

but as soon as she begins turning, the distance will be opened again by her own loss of speed and the taking up of speed again by the ship ahead.

Once a too wide sweep has been made by the bad turn of a ship, it is not so easy for the ships astern to avoid it, because the direct follower, wishing to remain on the correct arc of turning, is likely to come very close to the displaced ship ahead, and is thereby often led to commit the same fault. This applies especially to the night, notably when going with screened lights, because then the darkness makes it difficult to make out the ships already standing on the new course, and consequently to recognize the fault of the ship ahead in time.

From the foregoing, the following rules for making changes of direction of column may be derived:

1. See that the ship, when the next ahead begins to turn, is kept as accurately in station as possible; on no account be appreciably too near. In order to avoid this, the speed, if necessary, must be at once reduced as required, at the hoisting of the turning signal. In large turns especially (of 8 to 16 points), too little distance is uncomfortable and likely to result in going wide.

2. Keep accurately on the course, as soon as the next ahead begins turning. If no suitable objects for the helmsmen are available ahead and it is not possible to depend sufficiently upon the steering compass (which is in the conning tower), on account of too sluggish movement, then have the course continually checked from the standard compass; and also, by day, look astern, in order to detect at once any turning of the ship by the deviation of the stern to the right or left from the rest of the column following after.

3. Begin turning at exactly the same point as the ship ahead, on the supposition of course that she turned correctly. In doing this the first few times, one must at once look for marks by which to fix the time for beginning to put over the helm. For the ships of the *Braunschweig* class (battleship, 13,000 tons), for instance, when one's own ship at standard distance is correctly in station and is holding the course accurately before turning, the following marks may be given:

(a) The passing of the flagstaff of the ship ahead through the jackstaff.

(b) The approaching of one's own bow to the swirl of the ship freely from the fore bridge. In a dark night, the time required for passing over the distance between the stern of the ship ahead and one's own bow at the known speed may furnish a good clue. The time counts from the moment when one observes the deviating of the stern of the ship ahead, by the moving of the stern light. Here also, one must be in station when this turning mark is used. Of course no absolute dependence may be placed on such marks, because they are influenced by faults in one's own position and in the turning of the ship ahead; but they are always a more or less good clue.

4. Keep your ship during the turning in such a way, be proper use of rudder, that the bow will always be somewhat within the wash of the ship ahead. For the ships of the *Braunschweig* class, a ship's beam is a good measure. On no account get outside the wake of the ships ahead.

5. Better begin turning too early than too late. Turning too soon may be easily rectified by easing the helm and, if necessary, reducing the speed. Turning too late almost always results in going wide and endangers the unity of the line. When, from any reason, the helm was moved too late, however, then at once apply a larger or the full helm angle, and energetically increase the speed, because otherwise one always drops behind. During the course of turning, notably during its last part, the observing of the angle between the column already formed on the new course and the midship line, from the conning station to the stem, will furnish a good clue to determine whether the ship with the helm kept as it is will still come around in time or not.

6. If you had reduced the speed before turning because too close, then, when beginning to turn or very soon afterwards, resume standard speed; otherwise you will be sure to drop behind. In some circumstances, even an increase of speed will be necessary.

7. When the ship ahead, by faulty turning, goes outside the arc of turning of the guide ship, then with all attention avoid repeating this fault. In such a case, take your direction from the ship preceding her, or if she be already out of sight, then from the line of the ships that have already turned, and, if necessary, bear a weatherly helm, in order not to come too close to the ship ahead. In turns up to 8 points in such a case, you may, without any fear,

head at first for the middle or even the bow of the ship ahead. If need be, there always remain the stopping of the inboard engine and a reduction of speed. When the fault of the ship ahead is great, you will in most cases range alongside of her at a pretty close distance.

8. When the ship ahead is turning correctly, then, before or during your own turn, only reduce speed if really necessary, because every reduction of speed means some disturbance of the ships astern. Also increase speed again as soon as possible, otherwise you will almost always get behind.

9. As the leading ship, one must after a turn at once come to the course accurately, because otherwise the manœuver will be made difficult for the ships astern, and the forming of the properly aligned column on the new course may be materially delayed. For aids to getting the ship on the new course quickly, see the remarks under C.

The correct and careful execution of turns (up to 16 points), is an excellent criterion for the seamanlike cruising of individual ships and of the entire squadron. It is therefore to the best interest of every watch officer to improve continually as much as possible in this undoubtedly not very easy art.

C. SIMULTANEOUS TURNING.

After a turn together has been carried out, the ships should at once lie correctly in the new formation. To secure this, the squadron helm angle must be exactly known, the turn must be begun promptly when the signal goes down; while turning, regulating must be done, by increasing or reducing the helm, as well as by changing speed, in case the ship were not in station when the turn began, or is getting out of station during the turn; and finally, uniform procedure must be observed on board all ships, in easing the helm and meeting her. After the completion of the turn, the position should be promptly corrected, if necessary, in order that the line may be dressed in the shortest time. With turns of 16 points when in column, this is not so simple, because in the first place it is difficult to judge whether you are outside the line to the right or to the left. Deception in this regard is possible notably when the guide ship does not at once get steady on the new course. It is best to observe by the double glass, during the steadying, what the approximate new line of

dressing will be, according to the position of the ships in front; then you will soon get a reliable clue for your own correction. The rapidity with which the line in such a case is re-established is also a good standard for judging the efficient handling of individual ships and of the squadron. Some indication as to the side to which correction will probably be necessary may be obtained also by taking a bearing of the new guide ship after turning 8 points. Any quick rectification of alignment, which of course must be made by every ship independently of the next ahead, becomes impossible, however, if the leading ship fails to steer a steady course at once.

When turning together from column to line, every ship ahead of the new guide ship must as soon as possible measure the distance from her former next astern, to see whether this distance is correct or not, and to be able still to make it up, if necessary, during the turn. For the same reason, when turning from line abreast into column, the ships lying between the old and the new guides, and the former guide herself, must at once measure the distance to the ship next towards the new guide.

In order that the watch officer may be able to make rectifications, and to ease and steady correctly, the last four points of simultaneous turns must be reported from the standard compass, always in the following manner: 4 points, 3 points, 2 points, 1½ points, ¾, ½, ¼, ⅛, Mark! When turning together 16 points also, this reporting of the turning by points is necessary. The final steadying on course is best left to the helmsman, giving the command: "Steady on the course," after meeting her and steadying. As stated above, it is desirable for the accuracy of cruising that, for easing the helm and meeting her in large turns together (4 points or more), the same procedure should be carried out on board all ships. In any case, within the ship, entire uniformity among the watch officers must be exacted.

D. To Anchor.

As a rule, anchoring is done in column or in a compound formation, seldom in line or line of bearing. The point is that, after anchoring, the ships may lie accurately in position. This can only be obtained if each ship endeavor to the utmost to be in station on the way to the anchorage, and to keep in station when reducing speed before anchoring. Any unsteadiness arising in

the column shortly before anchoring, by bad behavior of a ship, is extremely disturbing. This holds good especially for column, with which we are chiefly concerned. Close attention should therefore be paid to any forging ahead or lagging back, and any necessary correction of speed should at once be taken. A good angle taker should constantly observe the behavior of the ship and report. One's own observing of the crossbar on the jackstaff is, as a rule, not sufficient for the exact steaming that is necessary immediately before anchoring. Especially beware of being too far ahead, because this fault can be remedied soon enough only with difficulty, as the reductions of speed follow each other quickly. In case you are too close, when the signal "Stop, as soon as in station" goes down, the only means then available for correcting position is backing the screws, which, however, always means an offense against the ship astern of you and therefore should be strictly avoided. For the same reason, take care during the run with engines stopped not to still forge ahead of place, due to greater speed momentum. Good steering is, of course, very important for good keeping of station. In a well-trained squadron all the ships must anchor at about the same moment. It must not occur that the rear ships of the column anchor in succession, because of having kept somewhat back through overcaution, thus having to steam up to place after the leader has anchored.

E. WEIGHING ANCHOR.

After the anchor is aweigh, the ship must be kept on the same heading as before, until the signals about formation, course, and speed are hauled down. A frequent fault is that the rear ships start ahead too late, whereby at once the line will be lengthened out. It is of advantage to know the compass bearing of the line at anchor, because then the manœuvers necessary for carrying out the signaled orders about formation and course can be decided better.

F. DERANGEMENTS OF STEERING GEAR.

Although the entire steering gear is of course carefully examined daily before weighing anchor, and at least once daily while under way for a longer time than one day, cases of refusal or damage may occur, due to faults in operation or other causes.

The officer of the watch must therefore always know how to act in such cases. The necessary instructions are given in the proper place of the ship's regulations, in which the derangements to be expected in ordinary cruising, as well as in action, must be treated in detail. Each commanding officer will also make it his business to train the watch officers practically in this respect, by frequent exercises when cruising singly. It is to be observed from a general point of view, that, in case of any disablement of helm, one must at once endeavor to keep the ship on her course by means of the screws. If this appear to be impossible, on account of the position of the rudder or for any other reason (as for example, wind and sea), without endangering the safety of other ships or the continuity of the line, the prescribed breakdown signal must at once be given. The mere shifting from the steering engine (when the reserve steering engine is ready for use, as should always be the case in evolutions) must have been exercised so well that it can generally be carried out without making the breakdown signal and without any accident becoming apparent from outside the ship.

The watch officer is also responsible that his helmsmen shall be familiar with the steps to be taken in cases of disablement of helm, as far as they affect their stations. The call "Helm refuses" must not cause any commotion nor even momentary hesitation, neither with the watch officer himself nor with his helmsmen. On board a large ship there are usually, in addition to the conning tower, the following reserve steering stations, each of which are occupied by one man, and which can therefore be immediately used upon uncoupling the connections farther ahead: the central station, and the main or reserve steering engine spaces (according to the engine in use). The duties of the several stations must be definitely prescribed by regulations, carefully prepared and posted in the rooms in question, and the watch officer must continually care for sufficient instruction and oversight of the men.

In case of all those disablements of steering-gear in which men below decks have to steer, exact keeping of course or station by the assistance of the compasses provided in the lower steering stations will generally not be possible. The watch officer, in a similar manner to the case of steering with the screws, will have to observe the behavior of the ship closely and at once counteract

any incorrect steering by direct helm commands. The main thing is not to allow the ship to become unsteady but to keep her as quiet as possible. It will, of course, be further advantageous to call the attention of the helmsman to all circumstances affecting the steering of a steady course, as for instance, the effect of wind and sea.

G. FINAL REMARKS.

If the watch officer should get into a situation where there is danger of collision, it is above all important to get the stem pointed clear of the other ship, since touching with the side or stern is always less dangerous for either ship.

Further, the watch officer, when cruising in narrow waters should remember that each ship is responsible for her own navigation. Blind following in the wake of the ship ahead under such conditions is often dangerous, on account of drift by current or wind. Careful observing of current and wind, and making the necessary allowance for it, must be insisted upon.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE ATHLETICS AND AMUSEMENTS OFFICE, FORT SLOCUM, N. Y.

By 1ST LIEUT. PAUL D. BUNKER, U. S. Army.

It having been suggested to the writer that due to the prominence of athletics in the Army and the Navy, and to the unique functions of the above named office filled by him, a description of some of the features of said office with respect to the manner of handling recruits at this post would be of interest to many naval officers, the attempt is made to set forth certain activities that are not prevalent at other Army posts.

In the first place, in order to form an idea of the conditions, it may not be amiss to state that Fort Slocum is one of the five recruit depots supported by the War Department. Practically all of the applicants for enlistment east of the Mississippi River are sent to Fort Slocum for final examination and acceptance or rejection, as the case may be.

The strength of the garrison varies, running as high as 1500 men, at times. The organizations at the post consist of the 1st, 2d, 4th, 6th, 21st and 25th recruit companies, general service, infantry, the first named being a band. Each company is composed of a certain neucleus of picked soldiers, termed the "permanent party," and of recruits. Incoming recruits are assigned to these companies as equally as may be, are given a course of instruction in the fundamentals of the military art and then shipped to their regiments as called for by orders issued from time to time by the War Department. This course of instruction is intended to cover a period of about two months, but a demand for recruits may shorten this time to a few days, as was illustrated during the Mexican border trouble. These recruits, due to the amount of drill, study, etc., required of them, are not

allowed to leave the depot during the first two months, which fact has considerable bearing on our policy of handling them.

The permanent party before mentioned consists of about 17 sergeants, 10 corporals and 25 privates for each company. From these are chosen the drill sergeants, extra and special duty men and all others on duty pertaining to the administration of the depot.

It is not the object of this paper to inquire into the methods of recruit instruction as regards purely military work, such as guard duty, etc., but to show what is being done in a certain department which should be equally interesting to Army and to Navy alike. The activities referred to are centered in the "Athletics and Amusements Office," which title is fairly descriptive of the work involved.

The general duties of this office are to supervise all forms of athletics on the post, and to provide means of entertaining the soldiers at times when they are not on duty. These duties will be discussed under the two separate heads indicated in the title to this paper.

I. ATHLETICS.

Of course, in the limited time at our disposal, it would be absurd to attempt making a finished athlete of the average recruit. The advisability of such results, even were they possible, is open to question. Therefore, the main idea underlying the athletic instruction of the recruit, is to "get him off his bunk" and to put plenty of fresh air into his lungs. Of course the regular "setting up exercises" are used in drill every morning, but that is considered insufficient. Hence, every Tuesday, Thursday and Saturday afternoon all recruits that are not actually on duty (guard, drawing clothes, kitchen police, etc.) are given two hours systematic exercise according to a prescribed schedule as noted below. Each company is allotted a certain portion of the parade ground, and the recruits exercise thereon, under the direct supervision of non-commissioned officers known as "squad instructors." Each of the latter controls about a dozen men, there being a selected sergeant in charge of the whole company who sees that each squad complies with the schedule ordered.

Now two hours is a long time, when an athletic drill is considered, and if the go-as-you-please method were allowed, the men

would be bored to death before the time was half over, and but little benefit would result. The principles involved in our solution of the problem can be seen from the following letter, which is, in tenor, a copy of that submitted by the athletics and amusements officer (hereafter designated as the A. & A. O.) on the 15th of every month.

RECRUIT DEPOT, FORT SLOCUM, N. Y., July 15, 1911.

The Adjutant, Depot,

Sir: In compliance with G. O. 13, c. s., Depot, I have the honor to submit the following schedule of exercise for the month of August, 1911:

1. The various company commanders will see that their squad instructors thoroughly understand the working of the schedule laid down hereafter, and will see that all apparatus or material required by the exercises is on hand.

2. The copies of "Indoor and Outdoor Gymnastic Games" provided are for the use of the squad instructors, who will conduct the exercises according to the rules therein.

3. Each squad will exercise on the parade ground under the supervision of its squad instructor; it will not leave the parade, or be joined to another squad except by direction of the athletics and amusements officer, or in case the squad instructor is unavoidably absent.

4. The non-commissioned officer in charge of each company's athletics will distribute his squad among the others present, and will devote his time to seeing that the squad instructors observe the schedule below.

5. After each day's exercise, the squad instructors will endeavor to have the men of their squads acquire the habit of taking a shower bath immediately after returning to their barracks.

6. The exercises for the month of August will consist of the following:

1. Boxing.
2. Medicine ball.
3. Football practice in kicking and catching.
4. Hurdles.
5. Pole vaulting for height and for distance.
6. High jumping, standing and running.
7. Soccer practice in dribbling and passing.

7. The above exercises are shown by their numbers in the schedule below, and will be performed by each squad in the rotation indicated. Duration of each exercise, 20 minutes. The non-commissioned officers in charge of each company's athletics will be responsible that the squads change from one exercise to the next at the proper time, and will use a whistle or other means of securing the prompt attention of the squad instructors.

8. Each company will exercise according to the following schedule:

No. of Squad.	Sequence of Exercises. Aug. 1-10, inc.	Aug. 11-20, inc.	Aug. 21-31, inc.
1 and 6	1-2-3-4-5-6	3-2-1-4-6-7	1-2-3-4-6-7
2 and 7	2-3-4-5-6-1	2-1-4-6-7-3	2-3-4-6-7-1
3 and 8	3-4-5-6-1-2	1-4-6-7-3-2	3-4-6-7-1-2
4 and 9	4-5-6-1-2-3	4-6-7-3-2-1	4-6-7-1-2-3
5 and 10	5-6-1-2-3-4	6-7-3-2-1-4	6-7-1-2-3-4

9. At 2.30 p. m., all recruits who desire to swim will be assembled by the next-to-senior non-commissioned officer and marched to the bath house. He will preserve order in the line obtaining suits, and will see that all of his men return their suits when they are through using them. Men who do not care to go swimming will continue exercising on the parade, according to the above schedule.

Very respectfully, etc.

Advantages of this Method.—1. Due to the fact that the exercise period is divided into six parts, there is no difficulty in securing the necessary variety. Changing from one exercise to another serves to break up the time and make it seem much shorter than it really is. It thus serves as a very effective sugar-coating, for as soon as exercise becomes work, you cease securing the best possible results; hence it follows that you should keep the men interested, and unconscious of the fact that they are, in reality, doing good hard work. The variety of the work thus secured also enables us to avoid too much exercise with one particular set of muscles and to secure the all-round development of the recruit.

2. It fulfils the military requirement of efficient supervision. A glance at the schedule will show exactly what each squad should be doing at any particular moment.

3. By proper choice of exercises, it enables us to make a more efficient use of whatever ground space may be available.

4. Being compulsory, it brings out those men who are diffident. Most men dislike performing any athletic "stunt" when they know they cannot do it well. By this system their diffidence or backwardness is dissipated by observing that there are others equally unskilful.

In the selection of the exercises for this schedule a multitude of circumstances arise that closely circumscribe our choice. Especially is this true in winter, when the snow-covered ground renders many forms of exercise impossible. As another instance, running must be indulged in cautiously, as the effect of excessive

work in this line would be very detrimental to the average new recruit. The same applies to other forms of strenuous exercises. On the other hand, the work should be distinctly recreative in its nature, and dull treadmill exercises be avoided.

Therefore each exercise on the schedule is the result of much thought and deliberation. It is found that the best results are obtained from those exercises that are athletic in their nature (as distinguished from calisthenic) and that depend for success upon some knack, or that develop a spirit of rivalry. For example, good results are obtained from a judicious use of hurdles. The standard distances are laid off and two or three low hurdles placed at the proper intervals. A squad is allowed to negotiate them once according to their own ideas. After every man has managed to do this "stunt," one of the best hurdlers on the post is sent over the hurdles at top speed. The ease and smoothness of his performance contrasted with the slowness and awkwardness of that of the recruits never fail to make a profound impression and preach a sermon better than an hour's talk.

No matter how "soft" a man is, he can hardly hurt himself over a few hurdles. This particular exercise is good for the legs and abdominal muscles, it affects the "wind" to an unlooked-for degree, and is especially good in helping a man to "find himself." Also, practicing hurdles in this manner is a fair example of sugar-coated work; that is, while the recruit is being improved physically and is actually doing a fair amount of muscular work, this work being disguised as athletics, the man is cheerful and therefore gets much more benefit than he otherwise would.

Boxing is another exercise that is strongly favored, and is especially interesting to the men, there being some very creditable boxers among them, though they are fewer in numbers, perhaps, than in the Navy. To further the interest shown in this particular exercise, we hold monthly boxing exhibitions during the colder months, consisting of four or five "preliminaries" of four rounds each between such soldiers as may desire to compete. These bouts are run according to the rules of the Amateur Athletic Union. We also usually engage a couple of professionals from New York City to go on for six or ten rounds in order to give the men an exhibition of how it really should be done. The soldier contestants are allowed a small sum of money with which to buy the "rub-down" and other minor adjuncts in which the amateur

mind delights. The contestants for the main bout are hired for whatever we have to pay, and no distinction is drawn between the winner and the loser; they receive equal wages. We are very careful to comply with the laws of New York on this subject, in order to leave no loophole of attack by outsiders claiming that we run prize-fights.

No admission is charged to these exhibitions, all members of the garrison being freely admitted. All those who desire to contribute toward defraying the necessary expenses of these exhibitions are given an appropriate souvenir of the occasion. Deficits are paid by the post exchange, which finances all athletics and amusements at the post. These contests are largely attended by enthusiastic audiences, and to prove that there is nothing objectionable about them, many officers' families habitually attend. No outsiders except personal friends of officers and enlisted men are allowed in the audience, and in the latter case these friends are allowed to enter only upon special permission from the A. & A. O. in each case.

In view of the fact that practically all officers are thoroughly familiar with the subject, nothing need be said of the advantages of boxing as a form of muscular and mental training.

To supplement the "company athletics" held thrice weekly, we hold a monthly field (or indoor) meet, in which are seen the results of the training and exercise given the recruit during the month. Here is a typical order organizing one of these meets.

General Orders } RECRUIT DEPOT, FORT SLOCUM,
No. 84. } NEW YORK, August 29, 1911.

1. A Track and Field Meeting will be held at this Depot on September 26, 1911, commencing at 1.30 p. m. The contestants will be recruits selected from the several recruit companies by their respective company commanders.

2. The order of events will be as follows:

Events.	No. of contestants from each company.	Points. 1st.	2nd.	3rd.
1. 100 YARDS RUN, (Trials)	4			
2. 220 YARDS HURDLES, (Trials)	4			
3. SHOT PUT (16 pounds),	2	5	3	1
4. 100 YARDS RUN, (Semi-finals)				

Events.	No. of contestants from each company.	Points. 1st.	2nd.	3rd.
5. 220 YARDS HURDLES, (Semi-finals)				
6. POLE VAULT, (1st Height to be 7 feet)	2	5	3	1
7. 880 YARDS RUN,	4	5	3	1
8. 100 YARDS RUN, (Finals)		5	3	1
9. 220 YARDS HURDLES, (Finals)		5	3	1
10. ONE MILE RELAY RACE,	4	5	3	1

3. The Athletics and Amusements Officer will have on hand at the field, the necessary lists of entries, tapes, watches, etc., required for the use of officials, who will procure same from him.

4. The non-commissioned officers in charge of each company's entries will report at the Athletics and Amusements Officer's Office at 11.00 o'clock on the morning of the meeting to receive their instructions and the numbers for their contestants. After these numbers have been given out no change in assignment of the same will be made except by the authority of the Referee.

5. Entries of each company, written on a single sheet of paper, will be sent to the Athletics and Amusements Officer by 9.00 o'clock a. m., on the day before the meeting. These lists will show the Christian name and surname of each contestant.

6. Running pants and running shirts will be worn by all contestants. No contestant will be entered in more than two events.

7. Contestants will be sent to the field under the charge of a non-commissioned officer who will cause the proper contestants in each event to report to the Inspector in the prescribed uniform promptly upon the "first call" for that event by the Clerk of the Course.

8. All officers and enlisted men not actually and unavoidably on duty will attend the meeting.

9. The rules of the Amateur Athletic Union will govern.

10. Officials will inform themselves as to their duties.

OFFICIALS.

* * * * * * * * *

BY ORDER OF MAJOR DUGAN:

H. B. CROSBY,
Captain 14th Cavalry,
ADJUTANT.

It will be noted that the company commanders *select* their competitors. That is, they try out the recruits of their companies and may require the best of them to enter the meet, regardless of the

personal wishes of the men concerned. No prizes are offered at these field meets. The results are announced in general orders, showing the number of points secured by the contestants of each company, in addition to the usual form. This helps cultivate a feeling of friendly rivalry among the various companies.

In our case, *esprit de corps* is harder to maintain than in the average organization, except, perhaps, among the permanent party men. This can readily be understood when it is remembered that the personnel of each organization, being composed almost entirely of recruits, experiences complete changes at very frequent intervals.

However, in spite of disadvantages, we manage to make a fairly creditable showing, as a glance at the following list of post records will testify. This list has been compiled from this year's field meets only, since it has but recently become the rule here of complying with the requirements of the Amateur Athletic Union in the matter of recording performances. To be sure, none of these records would last long at the average college, but it should be remembered that we are not training college athletes, but soldiers; and even if we were, one or two months will rarely make a record man from raw material.

POST RECORDS—FORT SLOCUM, N. Y.

100 yds. dash, 10-3/5 sec., Rct. Wm. T. Lemieux, July 25, 1911.

220 yds. dash, 25-2/5 sec., Rct. G. Minkler, September 15, 1910.

440 yds. dash, 57 sec., Rct. L. C. Devlin, September 15, 1910.

880 yds. run, 2 min. 2-3/5 sec., Rct. W. E. Bagley, October 20, 1910.

Mile run, 5 min. 9-3/5 sec., Rct. H. Butterworth, June 11, 1911.

40 yds. indoors, 4-3/5 sec., Rct. H. Arnold (twice) March 23, 1911.

120 yds. hurdles, 20-4/5 sec., Rct. C. R. Shaw, October 21, 1910.

220 yds. hurdles, 30-1/5 sec., Rct. T. Rielly, June 22, 1911.

Running high jump, 5 ft. 4-1/2 in., Pvt. R. O. McKeeby, May 26, 1911.

Running broad jump, 17 ft. 11 in., Rct. B. Smith, May 26, 1910.

Shot put, 16 lbs., 35 ft. 8 in., Rct. H. J. McGrath, September 15, 1910.

Pole vault, 9 ft. 6 in, Rct. J. Sebastian, October 21, 1911.

Athletic Teams.—During the winter months each of the five companies supports a basketball team. A regular schedule is made out in the A. & A. Office and the games are played twice a week. Last winter a fifty-game schedule was played—each team playing every other team five games. The winning company was presented a handsome silver cup. This year the number of games will be cut down to forty, in order to avoid interfering with the start of the baseball season. We had no team representing the post.

Last fall association football (soccer) was instituted among the regular games, and a team organized from each company. These teams played a forty-game schedule, and another silver cup was given to the winner. This game gives plenty of exercise to a considerable number of men, and is not especially expensive to support —much less so than is baseball. Injuries to the men are of rare occurrence.

The Rugby or American game of football was represented by a post team, and seemed to take better than any other form of team work, despite the havoc wrought by recent changes in the rules. Our team lost but two games, one being to the U. S. S. *Connecticut*.

During the summer, each company is represented by a baseball team, in a forty-game schedule arranged for two games per week. In addition to this, the post team played on Saturdays and Sundays against outside teams. We had no trouble in filling our schedule of about forty games with good teams that were willing to come to Fort Slocum for their travelling expenses and no other "guarantee." These expenses were paid by the post exchange, which also furnished us all suits, etc.

All of the above games are played partially with the idea of giving the men some recreative and interesting exercise, but since the number that can indulge in them is comparatively limited, the main object is to interest and amuse the great body of recruits that are not playing.

II. AMUSEMENTS.

Under this head are considered all functions of the A. & A. Office that are not purely athletic in their nature. In the discussion of these matters the writer will endeavor to give such

data as will help anyone to determine whether or not it would be advisable to institute similar activities at the station (or ship, where applicable) at which he may be serving.

During the winter months we have some function or other at the "Drill Hall" every evening of the week. In the summer, when the men can get more exercise out of doors, and it would be too hot for indoor games, only two evenings per week are given over to entertainments in the drill hall.

Moving Pictures.—A moving picture show is given twice a week in the drill hall, throughout the year, for the amusement of the recruits, though everybody at the post is welcome. Indeed, many of the permanent party rarely miss a show, and the officers' gallery is usually crowded. Our "theatre" is an extemporized one in the drill hall: an operating room constructed on the gallery floor, and about 450 folding chairs of the settee pattern, which latter are also used in connection with all the other entertainments in the hall. Our curtain drops from one of the roof trusses and is rolled up when not in use. Our equipment consists of a Beseler stereopticon with right-angled carbons, the lower lamp being on rails to permit its being used with the moving picture "head." The latter is an Edison Underwriters' Model, Type B, with a "two-wing, inside shutter," which gives satisfaction. Our throw is about 63 feet and our picture about 13 by 18 feet. A competent soldier as operator is giving satisfaction. The fact that circumstances require us to use alternating current makes it hard for any except expert operators to get superlative results as far as illumination of the picture is concerned. Users of d. c. are comparatively free from these troubles.

We hold these shows on Tuesday and Friday evenings of each week, and four full reels are run at each show. We also put on four illustrated songs, and this is what necessitates the stereopticon. Sometimes we run two vaudeville turns instead of the songs, single acts "in one" being the rule. For this purpose we erect a portable stage in front of the curtain, using one of the sections of our boxing platform. All talent, films, etc., are obtained from New York City, from certain agencies that have been found to give us the best satisfaction.

The above program, including five minutes intermission for the benefit of the inveterate smokers and others, averages about 2 hours. An admission fee of ten cents is charged, "canteen

checks" being accepted. Our tickets are in rolls as usual, the tickets of each roll being numbered consecutively, and the rolls being of different colors to prevent fraud. When the men enter, their tickets are torn in half, the numbered end is presented to them, and the other half deposited in a box the key to which is kept in the possession of the A. & A. O. This is to prevent anybody from using the ticket over again. As we have an intermission at every show, the numbered halves of the tickets serve as door checks. This method is less troublesome, though perhaps less efficient than having regular door checks.

The slides for announcements, etc., are made usually on transparent gelatine bound between the usual plain glass plates. An outfit can be bought from any of the established dealers for $3.00, which by the way is exorbitant. These strips of gelatine will melt if left too long under the influence of the heat of the arc. Another very simple way is to write your notice on a plain glass slip with Chinese white, which of course will be rubbed off in a short time, but is good enough for emergencies. A better way is to use opaque marl, which can be obtained with full directions from any dealer in photographic supplies.

Piano music makes a most agreeable accompaniment to the pictures, *provided* your pianist is really good. The same can be said of a trap-drummer. In moving picture circles you hear much talk of "jackass music." This term is easier to illustrate than to define. When you are showing a weepy scene with the poor heroine leaning over her dying che-e-ild, and the idiot at the traps thinks it is a good time to try his "baby-cry" squawker —that is jackass music. When the Spanish girl dies, through a hundred feet of film, all to the strains of a lively Fandango and castanets—another case of jackass music. But properly handled, a piano and a good set of traps will add immensely to the attractiveness of a show.

There are numerous tricks in this trade, many of them most interesting, but space prohibits further dilation. The average reader, thinking perhaps of the advisability of securing an outfit for his post or ship, is more interested in the financial side of the proposition. With us, the installation is paying for itself, but that was about all until the last few months, when the average attendance has substantially increased, and bids fair to give better returns. There are several reasons why large returns are not

realized, the principal of which is that only one exhibition of each collection of reels is made. In civilian life a dozen or more "shows" might be given for the same expense of film rental that we are paying. We show each film but once, the four reels making up one show. These reels cost us $2.00 apiece for each night. Our expense account for one show would run about as follows:

Film rental	$8.00
Pianist	5.50
Singer (furnishes slides)	5.50
Operator, soldier	1.00
Salary, attendant, pro rata share	1.12
Electric energy (0.05 per kw.-hr.)	0.20
Fare of messenger for films	1.00
	$22.32

In case vaudeville is substituted for illustrated songs, the cost would be $28.82, as we pay $6.00 for each single turn. We rent our films from a certain "licensed" exchange which, after considerable experimenting, we have found will give us the best value for our money.

Due to a variety of causes, we formerly averaged but slightly over 300 paid admissions, but during the last two months we averaged better than 400. In this connection, however, it should be remembered that many of our recruits, having just arrived, have not yet received any pay. At other stations the attendance might be larger, especially at an isolated post, or on board ship, where you could rely upon an attendance of nearly the whole personnel that happens to be off duty. Excluding the 500 chairs, our outfit cost about $600.00 installed ready to run, so it can be seen that while this enterprise is not exactly a get-rich-quick scheme, it is reasonably sure to yield a good profit on the money invested. Take our case; charging all expenses against the receipts for the last eight months we show a clear profit of $315.00, not considering first cost of the outfit. In many cases the above list of expenses could be curtailed, but whether or not this would be a profitable venture for the average "canteen" with a limited supply of surplus capital is a question that would have to be settled separately in each case. The effect of outside competition would have to be reckoned with, in the case of almost all stations ashore. About the only way to compete is to beat your opponents in the

quality of show you give. We are so near New York that even if we didn't particularly care to, we must throw a good, clear, steady picture or none at all. Not that all New York shows have good pictures, but the idea is that we must be as good as the best, otherwise the recruits who know good shows when they see them would "knock" and keep other men away. This necessitates hard work, but comparison with the best has shown that except for infrequent occasions we project as good a picture as any house in the city. With the enlisted experts in each arm of the service available, this is not an impossible task. The Army and the Navy are better situated in this respect than the civilian exhibitor. Apparently the Navy has no trouble in handling this proposition, as we have noticed at the "exchange" where we get our films large consignments of films for several ships of the Navy.

Roller Skating.—If returns on money invested are desired, roller skating is about as good a venture as can be desired, at least it was found to be so in our case.

In December of last year we bought 100 pairs of the best rink skates obtainable. They cost $320, and "took" so well that 50 additional pairs were bought about a month later. The main floor of the drill hall, about 80 by 150 feet, was given over to skating from 7 to 9 p. m. on Wednesday, Saturday and Sunday nights and from 2 to 4 p. m. on Sunday afternoons. To keep out objectionable characters from nearby towns, only enlisted men were allowed on the floor. At first a charge of 10 cents per hour was made for use of skates, but later the time was shortened to one and a half hours with a charge of 10 cents for the whole period. By the end of April the whole sum invested, including cost of repairs, spare parts, and extra pay of attendant, had been recovered, and next season the receipts will be practically "velvet" for the post exchange. Rules for running rinks and regulating skating can be found in Spalding's Roller Skating Guide, which will be a help to anyone embarking on this proposition, but there are many things concerning it that can be learned by experience alone. We used the roll tickets for this amusement as in the case of the moving picture shows, but they were of a separate color. When handed in at the door they were torn up and put in a locked box. Music was furnished throughout the skating by an orchestra, selected from the band, with brass predominating in order to be heard above the roar of the skates. The orchestra

received no additional pay for this work, for it was in lieu of the outside concerts that they play during the warmer months. Any soldier owning skates is allowed to skate at these regular hours without charge.

Any person who has tried this form of amusement knows that it is fairly good exercise, especially for the lower part of the body. It takes well with the men, but would probably be less popular without the music, and more so if women were allowed to skate. We have about two hundred chairs arranged against the wall for spectators, and as we use these chairs for moving picture shows, etc., it is not necessary to move them out of the hall. This gives ample seating capacity for the skaters and such of their friends and relatives as come to observe. Most of the skaters are men who have learned before they enlisted, but many beginners also are seen on the floor. The returns from this form of amusement indicate its popularity. This popularity holds out well in the spring and early summer months, but, as before stated, the recruit is required to remain on the post for his first two months. Probably, if our recruits were not required to remain on the post as they are, during the summer months the various summer resorts, minature Coney Islands, etc., would prove strong counter attractions. As it is, this and the other features described are results of their detention, not causes. That is, we try to amuse the recruit and keep him occupied *because* he is kept on the post. These features are for his especial benefit, and not for the permanent party man who can leave the post whenever off duty, though we also try to make things attractive enough to hold the latter against the outside attractions—and succeed fairly well.

Bowling.—We have four bowling alleys in the basement of the drill hall which are continually in use except during the warmest months. There are also several alleys in the Y. M. C. A. building, which is a gift of Mrs. Russell Sage. Formerly a small charge was made for the use of the former alleys, but this has long since been abolished, though they were used as much then as now. It takes one man working for a fair part of every day to keep these alleys in the best possible shape. If it is desired to start a set of alleys at a station, our figures seem to show that it would be a very profitable investment for the average post exchange, although the running expenses are fairly high.

Shooting Gallery.—Adjacent to the bowling alley is a well equipped shooting gallery, with the usual array of moving targets, bull's-eyes, clay pipes, ball jets, etc. This is quite popular with the men, especially during the winter months when entertainments are being held at the drill hall every night. At such times the net receipts have averaged close to $4.00 per day. The post exchange having installed this gallery, it of course reaps the financial reward from same. The outfit, including motor, etc., complete, cost about $300 installed ready to run. Apart from the benefits accruing to the men, the above shows that this gallery is a valuable and reliable source of revenue to the post exchange. No competitions for prizes are held, but if they were, of course the receipts would be correspondingly increased. By this means, if necessary, it is believed that a well equipped shooting gallery could be made a well paying investment for almost any post exchange.

We use the service Springfield rifle and adapters for cal. .22 short ammunition. The latter costs about $18.75 per 10,000 rounds and the men pay one cent per shot. We have just added a revolver to our equipment, and it seems fairly popular. The use of silencers might be an improvement, but has not been tried as yet. Dry cartridges are best for revolvers and greased cartridges for rifles. Difficulties arise in connection with the continued use of the adapters or "cartridge holders," and we are asking the Ordance Department to make us a few rifles as nearly as possible identical with our Springfields, yet obviating the use of adapters.

Swimming.—The post exchange has purchased 150 bathing suits of very good quality, which are available for free use by the recruits of the garrison during certain hours. This innovation is extremely popular with the men, and we could easily use twice the present number of suits. No definite course of instruction in swimming is given, but it is hoped we shall be able to take this up next year.

CONCLUSION.

The foregoing is an attempt to show what we are doing for the recruit. We realize that there are many imperfections in our methods, many places where improvements can be made. We intend to make those improvements as fast as circumstances will permit.

In every such step there are considerations not apparent to the casual observer that must be carefully weighed and examined on every side before the final step is taken. We are trying to build up a broad and definite system that will stand the test of time and endure, and for such work "Make haste slowly" is as good a motto as that adage beginning "He who hesitates."

It is believed that the A. & A. Office at Fort Slocum is unique, in that its activities are wider in scope than any other similar office in military or naval circles. It was partially for this reason that the above was written, and also with the hope that some of the facts above noted might be of use or benefit to others, thus saving them the necessity of learning by experience.

THE FUNDAMENTALS OF NAVAL TACTICS.

By Lieutenant Romeo Bernotti, Italian Navy.

Translation by Lieutenant H. P. McIntosh, U. S. Navy, Retired.

CHAPTER III.

Tactical Evolutions.

48. *Tactical Evolutions and Maneuvers.*—Let us consider a compact fleet with the units grouped in the manner deemed to be expedient for tactical action, and at the distance from each other which is established as the normal.

In contact out of range the objective of the movements may be that of delaying offensive contact, or of taking a determined position with respect to the enemy, arriving at offensive contact with an advantageous alignment. In general the tracks must be rectilinear. At intervals of time it may be necessary to execute changes of course or of alignment; that is to say, to perform evolutions; the fleet may then be ordered with the maximum exactness, and the control may be completely exercised by means of signals.

In offensive contact we find ourselves under conditions different from those just indicated; we ought to have *at every moment* an opportune alignment and a suitable inclination of the ships to it; therefore, in general (as has already been pointed out in section 17), an immediate and continuous adaptation of the proper maneuver to that of the enemy is desirable. Limited confidence can be placed in signals, because, aside from other things, they require for their transmission a time that is not inconsiderable, even when use is made of repeating vessels not stationed in the line. In order not to be surprised and disconcerted, it is then necessary to be prepared to maneuver on the basis of simple *directives*—each division imitating the movements of the one immediately under the orders of the commander-in-chief; and, analogously, the single ships of each division regulating themselves by the one among them that is charged with the conduct of the maneuver.

We must, then, necessarily admit that the evolutions cannot, in general, satisfy the necessities of offensive contact, reflecting (as already results from section 33) that they ordinarily require two changes of course of considerable amplitude, which disturbs the firing; moreover, when an evolution is ordered, it is necessary to

foresee what will be the tactical situation at its end, or, after a time that is notably long, when the naval force is numerous. Such a length requires the prevision alluded to, and, on the other hand, renders it very difficult—the enemy being free to maneuver according to his desire. It is to be observed that, naturally, this prevision is also necessary when an evolution is ordered in contact out of range; however, if in the course of the evolution we do not arrive at offensive contact, we may, at least in part, nullify the effects of an erroneous prevision, by so regulating ourselves as to delay the approach. Finally for the duration of the evolution, the movements of the single units are restricted; and it is clear that this restriction cannot permit the best employment of the weapons and satisfy the variability of the tactical situation. Let us, then, admit the principle that *in contact out of range we perform evolutions, and in offensive contact we maneuver; having, in the latter case, as little recourse to evolutions as possible.*

Definitions.—We shall call *tactical evolutions* those proper for the government of a fleet in contact out of range, thus distinguishing them from the multiplex evolutions that can be imagined.

Under the name of *tactical maneuvers* we shall include those maneuvers that are required for the control of a fleet in offensive contact.

In this chapter we shall study tactical evolutions, considering successively the hypotheses that the fleet may have a simple alignment and a double alignment. We shall subsequently refer to the case of separated groups in contact out of range.

49. *Evolutionary Speed—Reserve of Speed.*—As is well known, to the end that a ship may keep in the formation it is necessary for it to have a *reserve of speed;* or, the *normal speed* must be somewhat inferior to the maximum speed of the slowest unit. On the other hand, in order to render the evolution as rapid as possible, it seems to us well to establish that, as a general rule, the evolutionary speed shall always be equal to the said maximum speed of the slowest unit. Consequently, when, for instance, we say that *the evolution is performed with the speed ratio of* $\frac{1}{2}$, it is established that the pivot ship reduces its speed, not to one-half of the normal speed, but to one-half of the evolutionary speed.

The minimum reserve of speed that each ship in the formation should have at its disposition must be a fraction determined by the normal speed; or, it must be of greater value the higher is the

normal speed; in fact, a ship that is not exactly on the desired line of bearing, in order to get into position, determines *by eye* the small change of course necessary; but, as equation (3) of Chapter I shows, the amplitude of the change of course—and hence the time required to get into the formation—depends upon the ratio between the normal speed and the evolutionary speed, and not upon their difference. Let us admit that the minimum reserve of speed may be defined by the ratio

$$\frac{\text{normal speed}}{\text{evolutionary speed}} = \frac{9}{10}.$$

50. *Evolutions to be Considered for a Simple Alignment.*—In relation to what we established in section 18, let us consider a naval force composed of two elementary alignments, each of which does not contain more than six ships. Let the naval force be upon a single line of bearing.

As we said in section 12, the formation has of itself no importance. Having admitted this idea to be fundamental for offensive contact, we ought to take it *a fortiori* as a guide in the study of contact out of range. In the latter, given the objects that we may decide upon, the first element to be determined in relation to them is the course; when the alignment is adjudged to be satisfactory, or when a change of course is urgent, such change is made simultaneously.

This said, let us suppose that the fleet has the proper course, which we will call the *advantageous course,* and that it is desired to change the alignment. The evolution to be performed consists in a change of polar bearing, which may be executed by one of the following methods:

1st. By changing course in succession (contromarcia).

2d. By oblique courses.

3d. By methods based upon the wheeling of the single column.

51. *Change of Course in Succession.*—In order to satisfy tactical necessities, from among the ways in which this method may be applied, we should select the one *that permits of losing the least distance in the direction of the advantageous course.*

The problem being thus set forth, it results therefrom that the transitory courses during the evolution should not make with the advantageous course an angle greater than 90°.

Let $A_1 \ldots . A_n$ (Fig. 26) be a line of polar bearing a. A_1Z being the initial course—which we will suppose to be the advan-

tageous course—the transitory course must be included in the semicircle X_1ZX_2, X_1X_2 being normal to A_1Z. Desiring, then, to assume an alignment Y_1Y_2, it is to be observed: 1st, that it is not well to execute the evolution *in inverse order;* that is to say, by changing course simultaneously in the direction A_1A_n, which is without the said semicircle; 2d, that, for the same reason, in the evolution in direct order, that is, changing course simultaneously in the direction A_nA_1, it is not well, after such change, to execute the change in succession in the direction A_1Y_1, although the angle TA_1Y_1 is smaller than TA_1Y_2.

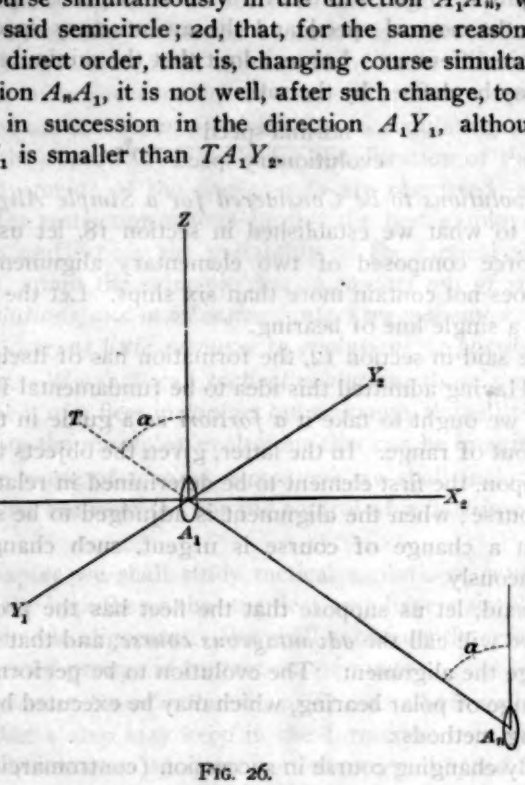

FIG. 26.

The rules for the evolution are hence the following:

1st. The ships change course simultaneously through the angle toward the ship farthest advanced in the direction of the advantageous course, resulting thus in a column of vessels.

2d. The leading ship, followed in succession by the other ships, changes course in the direction of the new alignment which makes the minimum angle with the advantageous course.

3d. When the last ship has completed the turn in the wake of the leading ship, the ships change simultaneously to the advantageous course.

It is to be noted that the change of course in succession, which constitutes the second part of the evolution just described, can be executed at evolutionary speed rather than at normal speed, because a ship that may have fallen slightly behind may put itself exactly in position by not following exactly in the wake of the one that precedes it, when it makes the turn.

52. *Oblique Courses.*—With the method by oblique courses, as has already been said in section 33, the extreme ship toward which the alignment inclines, reduces its speed, and the ships change course through an angle given by an appropriate table. If the angle of the change of course were estimated by each ship, that is to say, if it were not sought to determine it with the aid of a table or an instrument, it could only result in the employment of a longer time for the evolution, without any gain in simplicity.

The angle of the change of course could be determined as indicated by Admiral Morin in his profound work entitled *Degli ordini e delle evoluzioni di' un' armata* (*Rivista Marittima*, 1873-1874); but even in that case the evolution would not be completed in the minimum time.

It might also be prescribed that the intermediate ships of the formation should regulate their speed so as to arrive simultaneously on the new alignment; but the reasons for so doing are insufficient, while, on the contrary, for the case in which it is necessary to confront an unforeseen situation, it is preferable that each ship should arrive on the new alignment as soon as possible, as was proposed by De Gueydon.

The maximum value of the speed ratio that can be adopted in evolutions must be inferior to the value $\frac{9}{10}$ established in section 49; that is to say $\frac{8}{10}$. On the other hand, as we have already said in Chapter I, the minimum value that can be adopted for this ratio is $\frac{1}{2}$.

This being the case, it seems logical to perform evolutions with the ratio $\frac{1}{2}$ when the rapidity of the evolution is principally required, and adopt the ratio $\frac{8}{10}$ if rapidity must be sacrificed to the condition of losing the least distance possible in the direction of the advantageous course; it is well, however, to make a few reflections in this connection.

Let us indicate by V_A the evolutionary speed, and by V_B the speed of the pivot ship. Let t' and t'' be respectively the times

employed in a change of bearing of an amplitude ω with the values $\frac{1}{2}$ and $\frac{8}{10}$ for $\frac{V_B}{V_A}$. By formula (6) of Chapter I we have:

$$\frac{t''}{t'} = \frac{V_r'}{V_r''}. \qquad (1)$$

V_r' and V_r'' being the relative speeds corresponding to t' and t'' that are deduced by the formula in section 31, which gives V_r; this formula can be written:

$$V_r = V_A \sqrt{1 + \left(\frac{V_B}{V_A}\right)^2 - 2\frac{V_B}{V_A}\cos\delta},$$

in which δ is the angle of the change of course given by equation (3) of Chapter I as a function of $\frac{V_B}{V_A}$ and $\beta_1 - \frac{\omega}{2}$; β_1 being the polar bearing on which the ships are found with respect to the pivot ship at the beginning of the evolution.

In the time t'' necessary for the evolution with the ratio $\frac{8}{10}$ the space passed over by the pivot ship, which we will indicate by p'', is given by

$$p'' = 0.8\, V_A t''.$$

Let us bear in mind that $\frac{9}{10} V_A$ is the normal speed; consequently, if the evolution is performed with the ratio $\frac{1}{2}$, the track p' of the pivot ship in the time t'' is evidently

$$p' = 0.5\, V_A t' + 0.9\, V_A (t'' - t');$$

and hence we have

$$p'' - p' = \left(0.4 - 0.1\frac{t''}{t'}\right) V_A t'. \qquad (2)$$

Let us indicate the ratio $\frac{p'' - p'}{V_A t'}$ by u; the values of $\frac{t''}{t'}$ calculated with formula (1), and those of u, which are obtained by means of (2), are assembled in the following table in which $\beta_1 - \frac{\omega}{2}$ is made to vary from 0° to 90°, bearing in mind that with supplementary values of $\beta_1 - \frac{\omega}{2}$, formula (3) of Chapter I gives values of δ that are equal, but with the contrary sign; and hence the same V_r corresponds thereto.

$\beta_1 - \frac{\omega}{2}$	$\frac{t''}{t'}$	u
0°	1.4	0.26
30°	2.0	0.20
60°	2.4	0.16
90°	2.5	0.15

These values show that if $\beta_1 - \frac{\omega}{2}$ is included between 30° and 180° − 30° = 150°, and if the evolution is such that it is of long duration when executed with the speed ratio $\frac{1}{2}$, the advisability of the evolution with the ratio $\frac{8}{10}$ is to be excluded, because the greater distance gained in the direction of the course appears to be a negligible advantage when compared with the increase that is realized in the duration of the evolution; in other words, the time necessary for securing the benefit represented by the difference $p'' - p'$ is so long that we cannot rely upon the tactical conditions remaining stationary long enough to permit of completing the evolution.

For example, let us suppose the speed $V = 18$ knots an hour, or 558 meters a minute; let $\beta_1 - \frac{\omega}{2} = 75°$ and $t' = 10$ minutes, as is the case with a fleet of ships in line abreast at intervals of 500 meters, that wishes to change the bearing through 30°; we have, then, $t'' = 24$ minutes (about), and $p'' - p' = 0.16 \times 558 \times 10 = 890$ meters.

If $\beta_1 - \frac{\omega}{2}$ is less than 30° or greater than 150°, the angle of change δ is greater than that which would be required, for the same value of ω, in the case before considered; that is to say, with respect to that case, and with the same method, the evolution is more rapid; and it is to be noted that t'' diminishes more rapidly than t' because, as the table shows, the ratio $\frac{t''}{t'}$ diminishes while u increases; and hence the evolution with the ratio $\frac{8}{10}$ may really be advantageous. For example, for the fleet of 12 ships before supposed, when $\beta_1 = 40°$ and $\omega = 30°$, we have $t' = 7.5$ or $t'' = 12$ minutes, and $p'' - p' = 0.22 \times 558 \times 7.5 = 940$ meters.

Now let us note that in order to have $\beta_1 - \frac{\omega}{2} < 30°$, it is necessary for β_1 to be between $\frac{\omega}{2}$ and $30° + \frac{\omega}{2}$; but since, as a measure of safety, we cannot allow the course of the pivot ship to be crossed during the evolution, β_1 must be included between ω and $30° + \frac{\omega}{2}$; or, it must be greater than $150° + \frac{\omega}{2}$.

Moreover, considering that it is necessary to avoid excessively long evolutions, it is well that the evolutions with the speed ratio

$\frac{8}{16}$ should be restricted to the case in which ω is not greater than 30°; so that such evolutions, in view of the limits of β_1 just found, may be deemed advantageous *for lines of bearing nearer to the column of vessels than to the line abreast.*

When ω does not exceed about 10°, t' is small whatever may be the value of $\beta_1 - \frac{\omega}{2}$, and hence no importance can be attributed to the difference $p'' - p'$; however, as t'' is also sufficiently small, the evolution with the ratio $\frac{8}{16}$ is justified by the possibility of obtaining the object *with the minimum alteration of course and speed.* In other words, we may in general affirm the propriety of adopting the ratio $\frac{8}{16}$ when the evolution can almost be considered as a rectification of the formation. It is clear that in such case it is not advisable to apply the rule of De Gueydon for the change of course of the pivot ship; the course of the pivot must remain unchanged.

The evolution with the ratio $\frac{1}{2}$ is then advisable when ω is of considerable amplitude, and the formation is nearer to line abreast than to column of vessels.

53. *Change of Alignment by Wheeling.*—I. Admiral Bouet de Willaumez, in his *Projet de tactique navale* (1855), in which he laid down the basis for the evolutionary systems for steam vessels, in considering the wheeling of a fleet drawn up in line abreast, alluded to the system of pivoting on the center ship, one-half of the vessels going ahead and the other half backing; naturally, he discarded the method, since evolutions cannot be performed by going astern, and he limited the practical methods to those which pivot on one of the extremities of the formation. Nevertheless, the idea of the illustrious admiral can be applied to the wheeling of a column of vessels without need of backing the engines; in such case, as indicated by the anonymous writer in the United Service Magazine already cited (section 33, III), it is possible to change the alignment by pivoting on an intermediate ship of the formation; or, the line may be considered as composed of two parts, one of which has the pivot ship for a leader, and the other has it for the rear ship; and hence the first performs the evolution by executing the wheel on the leading ship, while the other makes the change of course necessary for wheeling on the rear ship.

On the basis of the idea already advanced that, tactically, it is not important to maintain a fixed formation, we may not, in gen-

eral, assign importance to wheelings; that is to say, it is not necessary at the end of the evolution to re-establish the polar bearing that the formation had initially; however, if the wheeling of a column of vessels can be executed rapidly by pivoting on an intermediate ship, we are induced to favor this method for changing an alignment, considering the column of vessels as a transitory formation, as is done in evolutions performed in succession. In other words, being upon any line of polar bearing α, in order to change the alignment we can change the course of the ships simultaneously through the angle α, thus bringing them into column of vessels, then execute the wheel on a conveniently selected pivot ship, and afterwards, with another simultaneous change of course, take the direction that is deemed advantageous.

In such an evolution the pivot ship evidently cannot maneuver according to the rule of De Gueydon, because the two parts of the line execute changes of course in contrary directions; hence, the pivot ship must alter the course through the angle ω, through which it is desired to change the alignment, and afterwards reduce speed in the desired ratio with the evolutionary speed.

After what has been said in section 33, it is easy to determine the criterion according to which the pivot ship should be selected.

Evidently, in order to wheel a column of vessels A_1A_2 (Fig. 18), the ship B most convenient as a pivot, is the one to which there corresponds an evolution of the same duration for each of the extreme ships, A_1 and A_2, that are respectively the rear ship and the leading ship. Having demonstrated that $\frac{A_1B}{A_2B} > 1$, it quickly follows that *the point of rotation is ahead of the center of the line.*

In particular, from the table of section 33, IV, which, for the speed ratio $\frac{1}{2}$, gives the values of the ratio $\frac{t_2}{t_1}$ between the duration of a wheel on the rear ship, and that of a wheel on the leading ship (or, it gives the values of $\frac{A_1B}{A_2B}$), we may deduce the ratio $\frac{A_2B}{A_1A_2}$; that is, the distance of the pivot from the leading ship as a function of the length A_1A_2 of the line. In fact, we have

$$\frac{A_2B}{A_1A_2} = \frac{1}{1+\frac{A_1B}{A_2B}} = 1 + \frac{1}{1+\frac{t_2}{t_1}}.$$

Indicating by t_3 the duration of the wheel when pivoting on B, it is clear that $\frac{A_2B}{A_1A_2}$ is equal to the ratio $\frac{t_3}{t_2}$, the values of which, multiplied by the corresponding values of $\frac{t_2}{t_0}$ given by the table of section 33, IV (t_0 being the duration of the evolution performed in succession), give us those of the ratio $\frac{t_3}{t_0}$.

In the following table are set down the values of the two above-mentioned ratios.

ω	$\frac{t_3}{t_2}$	$\frac{t_3}{t_0}$
15°	0.46	0.15
30°	0.42	0.29
45°	0.39	0.43
60°	0.36	0.55
75°	0.33	0.65
90°	0.31	0.75

These results show: 1st. That with ω greater than 60° the pivot ship may be held to be the one at about one-third the length of the column from the leading ship; while, if ω is less, the pivot ship is the one at about four-tenths of that distance. 2d. That the method of wheeling just cited is advantageous when compared to that performed in succession, especially for values of ω less than 60°.

From what has been said, the ships astern of the pivot ship should change course as in any ordinary wheel on the leading ship; but, for a certain number z of them, the evolution may be simplified by prescribing that they follow the pivot ship in succession on the basis of the following considerations.

As the pivot ship, after having changed course through the angle ω, takes up the speed $\frac{1}{2}V_A$, a ship that occupies the position z astern of the pivot, and which follows it in succession, arrives on the new alignment after a time $z\,\frac{d}{\frac{1}{2}V_A}$; d being the distance between two adjacent ships.

To the end that the said time may not exceed that occupied by the last ship of the line in executing the wheel, it is necessary to realize

$$z\,\frac{d}{\frac{1}{2}V_A} \leq t_3.$$

Let n be the total number of ships composing the line. The time that would be occupied in following the leading ship in succession at a speed V_A is expressed by

$$t_0 = \frac{(n-1)d}{V_A};$$

and hence we must have

$$\varepsilon = \frac{(n-1)}{2} \frac{t_2}{t_0},$$

in which the values of $\frac{t_2}{t_0}$ that it is necessary to introduce are those previously obtained. Under the two hypotheses of a line composed of 12 or of 8 units, the number of ships that can maneuver in succession astern of the pivot ship is given by the following table:

ω	$n=12$	$n=8$
15°	..	..
30°	1	1
45°	2	1
60°	3	1
75°	3	2
90°	4	2

So, as an illustration, with a line of 12 ships, wishing to execute a wheel of about 90°, the first four ships and the last three must perform the evolution at a speed V_A, while the five center ships must keep the speed $\frac{1}{2} V_A$.

In general, the difference of speed required for the center ship and for those at the extremities shows, as is noted by the English writer already mentioned, that this method of changing the alignment is *particularly advisable when the limited speed of the fleet is due to considerable differences in the maximum speeds of the various ships.* In fact, it has already been established that the normal speed must be $\frac{9}{10}$ of the maximum speed of the slowest unit; it has, furthermore, been affirmed that the evolutionary speed may be equal to the said maximum speed. This limit cannot be exceeded in evolutions performed in succession, and in those with oblique courses wherein one of the extremities of the formation is made the pivot, it being necessary that the angle of change of course be the same for all the ships. It is clear, however, that in order to obtain the maximum rapidity in wheeling the column of vessels by the method described, *if the divisions composed of the fastest ships are placed at the extremities,* such ships can avail

themselves, not only of the reserve of speed defined in section 49, but also that which results from the difference between the normal speed of the fleet and the maximum speed of the said divisions.

If the ratio between the maximum speed of the central division and the maximum speed of the extreme divisions does not exceed $\frac{8}{10}$, from what proceeds there results, within certain limits, *the possibility of wheeling the line without loss of speed to the fleet as a whole*, by executing the change of course ω in succession with the central division, and by the ships of the extreme divisions going to their positions with the reserve of speed. With the speed ratio $\frac{8}{10}$, this method may be held to be advisable when ω does not exceed 30°.

II. Let us suppose our fleet to be on any line of polar bearing α; let OS (Fig. 27) be the alignment, OR the course steered; and it

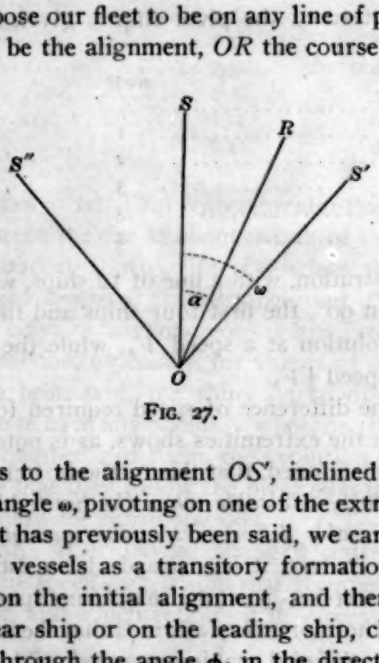

FIG. 27.

is desired to pass to the alignment OS', inclined to the present alignment at the angle ω, pivoting on one of the extreme ships. Analogously to what has previously been said, we can have recourse to the column of vessels as a transitory formation, by changing course together on the initial alignment, and then wheeling the column on the rear ship or on the leading ship, changing course in the first case through the angle ϕ_e in the direction of the new alignment, and in the second case through the angle ϕ_t in the contrary direction; ϕ_e and ϕ_t being the angles given by formula (4) and (5) of Chapter I. Let us observe, however, that the ships being, by hypothesis, already inclined by the angle α in the direction of the new alignment, the angle of change, instead of ϕ_e, is $\phi_e - \alpha$ in the case of pivoting on the rear, and $\alpha + \phi_t$ when pivoting on the head. Taking this into consideration, the evolution may

then be executed in the same manner indicated in Chapter I, for wheeling a column, without any complication whatever; because, according to the case, it suffices to subtract from, or add to, the angle of the change of course taken from the table for wheeling the column, the polar bearing of the formation.

It is obvious that the evolution is executed analogously if the new alignment is inclined the opposite way; thus, in Fig. 27, if the new alignment is OS'', the angle of change for wheeling on the rear ship is $\alpha+\phi_c$, and for wheeling on the leading ship it is $\alpha-\phi_l$.

Having thus generalized on the wheeling of the line, let us look into the importance to be attributed to such an evolution.

The party A (Fig. 28) has an alignment A_1A_2 in the direction of the course C_NC_N' of the enemy's center; it makes its alignment rotate through an angle ω, pivoting on the extremity A_1 farthest from the adversary. Since we leave it undetermined whether, with respect to the course of the fleet, the said extremity is farthest ahead or farthest astern, our reasoning is general and tends to establish the advisability of wheeling either on the head or on the rear.

FIG. 28.

For simplicity's sake, let us suppose that A_1 remains stationary during the wheel; the center C_A of A takes the position C_A', and the new inclination of the alignment, counting from the line joining the centers, is $A_2'C_A'C_N'$, which we will indicate by Ω. As Ω is an exterior angle of the triangle $C_A'C_N'A_1$, we have

$$\Omega=\omega+C_A'C_N'A_1\text{; and hence } \Omega>\omega.$$

The advisability of wheeling upon A_1 would hence seem to result from the fact that, while the alignment rotates through ω, it really approaches the fundamental position through an angle greater than ω; while if the wheel were made about the extremity A_2, the contrary would happen; and, finally, if the rotation were made about C_A, Ω would be equal to ω.

In practice, in wheeling the alignment the pivot A_1 would not remain stationary, and, by reason of its movement, the angle Ω might be increased or diminished according to the circumstances

of the case.* So, also, the wheel on the intermediate ship, as has been said in Part I of this section, would not be made exactly about C_A; but all this does not weaken the general reasoning which would lead us to believe it advantageous to take as a pivot the extremity of the formation farthest from the enemy.

It is now necessary to determine the value of the difference $\Omega - \omega$; this is clearly at the maximum when $\Omega = 90°$; and, $A_1 A_2''$ being the position of the alignment of the party A corresponding to such an hypothesis, from the triangle $C_A'' C_N' A_1$ we get

$$\tan \omega = \frac{r}{\frac{1}{2}S},$$

S being the length of A's alignment, and r the distance $C_A'' C_N'$, or the distance between the centers after the wheel. Supposing $r = 15{,}000$ meters, and $S = 5000$ meters, we have $\omega = 80°$ (about). Since the maximum value of the difference $\Omega - \omega$ is thus 10°, it appears to be negligible, considering the rapidity with which the alignment may be rotated by pivoting about one-third of the length of the line from its head. Also, under the hypothesis $r = 10{,}000$ meters, we have $\omega = 75°$ (about), or $\Omega - \omega = 15°$. *The importance to be attributed to the wheel when pivoting on one of the extremities is hence restricted to that which results from the study made in Chapter I,* in which it was established that, within certain limits, it may be preferred to the evolution in succession when the line is very long.

As has been said, on account of the rapidity, pivoting on the ship about one-third from the head of the line is preferable to pivoting on one of the extremities. Nevertheless, being on a line of polar bearing, the evolution just mentioned may be advisable, as it avoids the initial passage to the column of vessels. Having regard to the amplitudes of the changes of course that the method requires it is seen that *it is best to pivot on the rear ship if the course is inclined in the direction of the new alignment, and on the leading ship if the course is inclined in the opposite direction.*

54. *Angular Alignments.*—The angular orders, so much esteemed when the ram was considered the principal weapon, seem

* If A_1 were the rear ship, the angle Ω would also be increased, because the displacement of the pivot would be in the direction $A_1 A_1'$; while, if A_1 were the leading ship, the displacement of the pivot would be in the direction $A_1' A_1$; on the other hand, since we know that the evolution on the leader is more rapid than in the other case, we must conclude that we are confronted with contradictory elements. (Author's note.)

today to acquire new importance, but on a different basis, for the reasons adduced in Chapter III of Part I (sections 18 and 20). As we there pointed out, the angular alignments are advisable in offensive contact for the purpose of having each of the elementary portions of a composite alignment in fundamental tactical position.

This advisability commences in contact out of range at the moment when the limit of offensive contact is about to be crossed, with the application of the following rule, the necessity for which seems obvious.

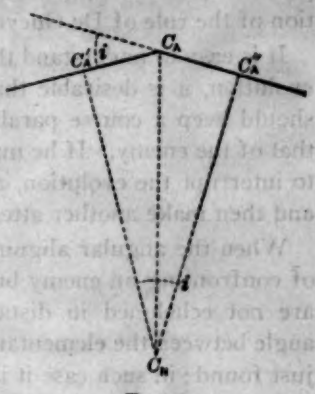

FIG. 29.

In contact out of range the fleet must be on a single line of polar bearing; if this is such that, when it is about to arrive at firing distance, one of the elementary alignments is in fundamental position, then, with such division taken as a pivot, the other elementary alignment may be changed so as to establish offensive contact in the most advantageous manner.

On the basis of this rule, under the hypothesis that the enemy has his forces compact, the limits within which the inclination i (Fig. 29) of the elementary alignment may vary, can be determined. Let C_A be the center of the alignment of the party A, and let C_A' and C_A'' be the centers of the elementary alignments.

Evidently the maximum value of i results under the hypothesis that the alignments must be in fundamental position with respect to one and the same elementary alignment of the enemy's formation which has its center at C_N. In such case we have

$$C_A'C_NC_A'' = i;$$

and hence

$$C_A'C_A = C_A''C_A = C_AC_N \sin\frac{i}{2}.$$

Indicating by n the number of ships in the A party, by d the distance between adjacent ships, and by r the distance C_AC_N, we obtain

$$C_A'C_A = C_A''C_A = \frac{(n-1)}{4}d;$$

therefore we have

$$\sin\frac{i}{2} = \frac{n-1}{4}\frac{d}{r}.$$

Making $n=12$, $d=500$ meters, $r=10{,}000$ meters, we get $i=16°$ (about). We may then hold $i=20°$ as the maximum value of i; hence the evolution may generally be executed by oblique courses with the speed ratio $\frac{8}{10}$. Evidently the pivot, instead of being a single ship, is composed of all the ships of the elementary alignment that it is desired to leave unchanged. The fact that the pivot is an assemblage of ships, renders inadvisable the application of the rule of De Gueydon for the double change of course.

It is easy to understand that, in order to obtain the object of the evolution, it is desirable that the ships forming part of the pivot should keep a course parallel to, and in the same direction with that of the enemy. If he makes a wide change of course, it is best to interrupt the evolution, assume the course that is deemed best, and then make another attempt.

When the angular alignment is brought about by the necessity of confronting an enemy broken up into independent groups that are not echeloned in distance—as represented in Fig. 11—the angle between the elementary alignments may be greater than that just found; in such case it is generally best to assume the angular alignment by interrupting an evolution in succession.

55. *Evolutions with a Double Alignment.*—One may be induced to perform evolutions with a double alignment (section 19), in contact out of range, by one of the following considerations:

1st. In contact out of range, as well as in offensive contact, it may be desired to keep the forces massed in that way.

2d. It is evident that one can perform evolutions more easily with a simple than with a double alignment of the same length; but it might be held that, given a certain number of ships, by placing them in double rather than in simple alignment, greater evolutionary facility might be acquired by virtue of the shortening of the line. Whenever evolutionary advantages with the double alignment present themselves, it might be employed in contact out of range, passing at the proper moment to the simple alignment in order to come into offensive contact.

A fleet in double alignment may be considered as formed by groups of four ships each in parallelogram (system of Labres*),

* See the résumé of Commandante Bonamico in *Rivista Marittima*, August-September, 1902.

or of three ships in a triangle (system of Fournier *); finally by groups of two ships, one in each line (twin system).

Let us consider evolutions performed by the ships in succession. The maximum simplicity and evolutionary rapidity would seem to be obtainable by causing each group of four ships to maneuver by simultaneous changes of course; in fact, small changes of the course of the naval force may be obtained by having each group make the change of course when it arrives in the wake of the preceding group. However, it is easy to see what inconveniences are encountered in so doing. Let us suppose a desire to change the alignment when the ships are on two lines of polar bearing and the lines joining the corresponding ships are normal to these lines of bearing, the distance between the lines being equal to the distances between ships, so that each group of four ships forms a square. By making all the ships of the fleet on the actual alignment change course simultaneously, we have the double column. In Fig. 30 there is represented a fleet composed of two groups that are already in that formation, and there is also shown the formation that results from a change of course in succession, following the rule above indicated. As is seen in the figure, the result is that *the ships are no longer in two lines, but in four;* and it is clear that they still remain in four lines when all the fleet executes the simultaneous change of course in order to return to the original course, or to take up a new course that is deemed advantageous.

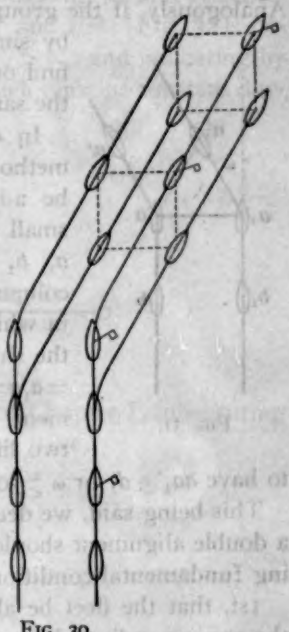

FIG. 30.

This sufficiently indicates that the method is not advisable, for the following reason:

* See *Rivista Marittima*, Vol. IV of 1907. In Fournier's system, the number of ships in one line of the alignment is half of that in the other line. With this system simultaneous changes of course are abandoned. (Author's note.)

In offensive contact, to the end that all the ships may fire, it is a necessary condition that they be not upon more than two lines. When the fleet is in two lines in contact out of range, on opening fire, it may be easy for the ships in the outer line with respect to the enemy, appropriately to modify their positions with respect to the ships in the inner line, so as to be able to fire through their intervals. This already constitutes a difficulty that, in practice, is not inconsiderable; but plainly we shall expose ourselves to the gravest risks if the matter is still further complicated by the fact that the ships are in more than two lines at such a critical moment. Analogously, if the groups of three ships each were maneuvered by simultaneous change of course, we should find ourselves forming three lines; which, for the same reasons, we believe are to be avoided.

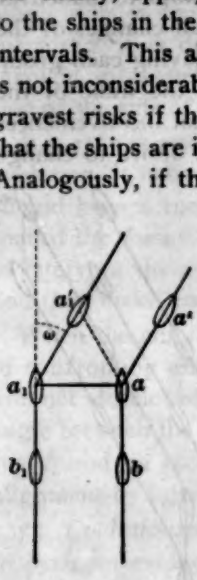

FIG. 31.

In evolutions performed in succession, the method of simultaneous changes of course may be adopted with the twin system only, for small changes of alignment. Indeed, let a, b, a_1, b_1 (Fig. 31), be four ships of the double column; when the ship b arrives in the water in which a has executed the change of course, the ship a_1 is in the position a_1' such that $a_1a_1' = a_1a = d$. To the end that, in the new alignment, the distance between the ships of the two lines may not fall below d, it is necessary to have $aa_1' \geq d$, or $\omega \leq 30°$.

This being said, we deem it indispensable that the evolutions of a double alignment should be executed on the basis of the following fundamental conditions:

1st, that the fleet be always in two lines. 2d, that, in general, the corresponding ships of the two lines should have each other bearing normally to the alignment; in fact, from this position the ships of the outer line with respect to the enemy, can, at the opportune moment and with the least possible difficulty, take the necessary positions for firing; and in this way we shall avoid a long alignment.

Furthermore, we shall hold that, generally, the number of ships composing the two lines should be equal, given the essential object which we have in view which is that of shortening the line.

The fleet may be drawn up on two lines of polar bearing α; α being any angle whatever, but the same for both lines. Let us

suppose the simultaneous change of course for passing to the double column to be already executed, as in the first position of Fig. 30, and let us see how, and in what time, the change of direction of the said column can be completed, in order afterwards to take up the advantageous course by a simultaneous change of direction.

From what has been demonstrated in section 41, it results that if two ships A and B, that have respectively the speed V_A and V_B, keep each other constantly bearing abeam, the tracks described by them are concentric circumferences. Letting ρ_A and ρ_B represent the radii of the circumferences AA' and BB' (Fig. 32), described respectively by A and B when $V_A > V_B$, and indicating by d the distance between the two ships (which remains constant during the movement), from formula (11) of Chapter I, substituting d for r therein, and making $\alpha=\theta=90°$, we have

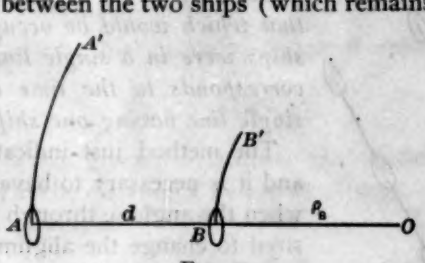

FIG. 32.

$$\rho_B = \frac{d}{\frac{V_A}{V_B} - 1},$$

while

$$\rho_A = \rho_B + d = \frac{V_A}{V_B}\,\rho_B.$$

To the end that the condition $\rho_B = d$ may be realized, it is necessary to have $V_A = 2V_B$.

Now let it be noted that, between ships in formation, the tactical radius about equal to the distance d is that which is ordinarily employed when d is between 400 and 500 meters. It results, then, that, when in double column, the leading ship B of the inner line, with respect to the change of direction, puts his helm over, he must reduce his speed to one-half that of the outer line, of which the leading ship A, at evolutionary speed, must steer, keeping B, by sight vane, constantly abeam. The ships of the outer line must

keep up the speed in order to keep themselves abeam of their corresponding ships.

If n is the total number of ships in the fleet, each line is then composed of $\frac{n}{2}$ ships; and hence the time t occupied by the evolution is expressed by

$$t = \frac{\left(\frac{n}{2} - 1\right) d}{V_B} = \frac{(n-2)d}{V_A}.$$

If, instead, the fleet were in single line, the time occupied would be $\frac{(n-1)d}{V_A}$; which shows that the *abovementioned method requires a time only slightly different from that which would be occupied if all the ships were in a single line, and exactly corresponds to the time occupied by a single line having one ship less.*

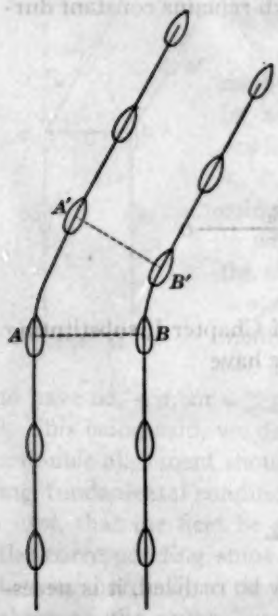

FIG. 33.

The method just indicated is general, and it is necessary to have recourse to it when the angle ω, through which it is desired to change the alignment, is of considerable amplitude; but, when ω is within certain limits, one can maneuver with greater quickness with the ratio $\frac{6}{11}$ between the speeds of the two lines, in the following manner:

The ship B, leading the inner line (Fig. 33), changes course through the angle ω in the desired direction, and assumes the proper speed for the abovementioned ratio; the leading ship A of the other line executes, with respect to B taken as a pivot, an evolution by oblique course, in order to bring itself again on the polar bearing 90°; that is to say, it completes—as is said in section 33, III—a wheel in line abreast; when A has made the wheel, that is, when it has arrived at the position A', it steers a course parallel to that of B and assumes the speed of B. The ships of each line follow their respective leaders in succession, and those of the outer line opportunely regulate their speed in order to keep themselves abeam of their corresponding ships. It is clear,

as Fig. 33 shows, that the change of direction to the new alignment will be completed when the last ship of the outer line arrives at A'; and, at the same time, the last ship of the inner line will be at B.

The duration of the evolution is hence

$$t=\frac{\left(\frac{n}{2}-1\right)d}{0.8V_A}+t_e=\frac{(n-2)d}{1.6V_A}+t_e;$$

t_e being the time necessary for the wheel of AB.

To the end that the duration of the evolution with the method may be less than that corresponding to the method by concentric circumferences before alluded to, we must have

$$\frac{(n-2)}{1.6}\frac{d}{V_A}+t_e<\frac{(n-2)d}{V_A}.$$

Making $\frac{d}{V_A}=t_0$, this inequality is transformed into another:

$$\frac{t_e}{t_0}<0.38(n-2).$$

The formula that gives the duration of the wheel of two ships in line abreast at the distance d, by virtue of what has been demonstrated in Chapter I, is

$$t_e=\frac{2d\sin\frac{\omega}{2}}{V_A\sqrt{1+\left(\frac{V_B}{V_A}\right)^2-2\frac{V_B}{V_A}\cos(\omega-\phi)}},$$

in which ϕ is the angle of change of direction for said wheel, which angle is equal to $\omega+\delta$; δ being the angle obtained from formula (3) of Chapter I, by placing in it $\beta_1=90^\circ+\omega$; in this way we get

$$\phi=\frac{\omega}{2}+\text{arc sin}\left(\frac{V_B}{V_A}\sin\frac{\omega}{2}\right),$$

wherein, in the case we are discussing, we must put $\frac{V_B}{V_A}=0.8$.

There are thus obtained the values of $\frac{t_e}{t_0}$ which are set down in the following table:

ω	$\frac{t_e}{t_0}$	n
15°	1.31	6
30°	2.59	10
45°	3.48	12
60°	4.54	14
75°	5.08	16
90°	5.87	18

With the values of $\frac{t_e}{t_o}$, taking into account the inequality above deduced, the values of n in the third column are calculated; which values indicate, for each value of ω, the minimum number of ships of which the fleet must be composed in order that the evolution performed in succession, following the wheel of the leading ships, may be advantageous with respect to the evolution by concentric circumferences.

It results from the preceding that, *in evolutions performed in succession, a fleet must be very numerous in order that it may be maneuvered on a double alignment with greater rapidity than on a single alignment.* Indeed, if the number of units is not very considerable, the angle ω must likewise be limited in order that the method by wheeling the leaders may be sensibly advantageous over that by concentric circumferences; which, in its turn, occupies a length of time not sensibly different from that required by a simple alignment. So, in order to fix the ideas, let us note that with twelve ships on a simple alignment, the evolution would require a time $11\ \frac{d}{V_A}$; while with the method of concentric circumferences the time would be $10\ \frac{d}{V_A}$, and, with the wheel, for $\omega=45°$, there would be a duration of $9.7\ \frac{d}{V_A}$. However, the advantage of this last method is rendered sensible with smaller values of ω.

The evolution by oblique courses, in order to satisfy exactly the two conditions established as fundamental, must evidently be executed according to the following rules:

1st. Simultaneous change of course in the direction perpendicular to the alignment. The fleet is thus arranged in two lines abreast, and the corresponding ships of the two lines are in column of vessels.

2d. The ships of the first line make a wheel in line abreast of the amplitude through which it is desired to change the alignment; the ships of the second line follow in succession, opportunely regulating the speed in order to maintain the distance from the corresponding ships of the first line.

3d. The advantageous change of course is assumed with a simultaneous change of direction.

It is needless to demonstrate that this evolution is little adapted to tactical necessities.

In double column the alignment might also be changed by wheeling each of the two columns so formed; but it is to be noted that there is applicable to such a case the observation already made in this section in connection with evolutions performed in succession by means of simultaneous changes of course of the successive couples of ships; that is to say, the said wheel must be less than 30° in order that the distance between the ships of the two lines at the end of the evolution may not fall below the normal distance.

We are now able to formulate the following conclusions concerning the tactical management of a double alignment.

Having a number of ships greater than twelve, the double alignment is convenient; evolutions with it must generally be performed in succession. Evolutions by oblique courses are long and complicated; hence it is difficult to take up in that way an angular alignment, and when the latter is deemed necessary, it must be assumed by interrupting an evolution performed in succession.

With about twelve ships or less, the double alignment would allow some advantage over the simple alignment in the case of evolutions performed in succession; but it must be borne in mind: 1st, that this advantage is sensible only within very narrow limits; 2d, that with the fleet on a double alignment, evolutions by oblique courses are performed with great difficulty; 3d, that, desiring to pass to a simple alignment at the moment of coming into offensive contact, an evolution would be necessary, which, on the other hand, would not be necessary if the forces were kept on the simple alignment from the start. In short, with a not very numerous force, keeping it, in contact out of range, on a double, instead of on a simple alignment, there would be a diminution rather than an increase of the maneuvering qualities of the fleet.

Finally, as pointed out in section 19, the double alignment may be advisable for the purpose of using antiquated ships in the second line; it is clear, however, that the number of such ships must be limited, so as not in the least to encumber the maneuvering of the line composed of modern ships. The double alignment formed in this way can be maneuvered as a simple alignment when the antiquated ships are not deficient in speed, and when there is only one of them for every three or four ships of the real line of battle. The said ships of the second line, without any suggestion of exactly determined positions, will regulate themselves

in the most opportune manner in order not to embarrass the maneuvering of the principal line.

56. *General Considerations Concerning the Evolutions of Compact Forces.*—Admiral Makaroff notes how it may be well to interrupt an evolution that is in progress. "While the fleet is changing its formation," he writes, "it remains in a transitory state of maneuvering, and the admiral can undertake nothing during that time without risk of causing confusion. A case, however, may arise wherein a change of formation ought to be arrested in order that all the ships may execute a simultaneous change of course. Short signals should be employed, and we proposed that the signal 'Come along!' (Via!) be hoisted. All the ships must then, as quickly as possible, assume a course parallel to that of the admiral and thus afford him the possibility of maneuvering."

These considerations are to be borne in mind. It may be important to interrupt an evolution when a change of course is urgent, or because the new alignment signalled is no longer deemed opportune. As the ship of the commander-in-chief may not be at an extremity of the line, let us establish that, in interrupting an evolution, the ships must assume a course parallel to that of the guide ship (regolatrice).

The possibility that an evolution by oblique courses may have to be interrupted, and that for this reason a disorderly formation may result, shows us the special importance that must be attached to evolutions performed in succession; indeed, with this method, after having changed course on the initial alignment and while the ships are changing direction successively in order to arrange themselves on the new alignment, if it is discovered that the said new alignment is not satisfactory, the leading ship can change course, causing itself to be followed in succession in order to form another alignment. Hence, evolutions performed in succession do not require prevision of the tactical situation at the end of the evolution in the same degree in which such prevision is required by the method of oblique courses.

Between two fleets opposing each other which at any given instant may have alignments equally inclined to the line joining their centers, differences may be created by the following causes:

1st. *Difference of speed;* in fact, with equality and simultaneity of maneuvering, the swifter party can deploy a greater number of ships.

2d. *Difference in the length of the alignments;* when they are of the same kind (simple or double).

3d. Delay in the execution of the counter movement.

This being the case, of the two adversaries, we will say that the better maneuverer is the one that has the greater speed when the two alignments have equal lengths, or that has the shorter alignment when the speeds are equal.

It is easy to admit that, for the party that is the worse maneuverer—which we will indicate by *N*—it is well, on sighting the enemy, to assume an alignment normal to the line joining the centers (the fundamental position), while for the party *A*, the better maneuverer, it may be well to assume a different alignment.

In short, let us suppose that, in this last case, the worse maneuverer does not assume an alignment in the fundamental position, but contents himself with keeping an alignment equivalent to that of the enemy. By virtue of his better maneuvering qualities, the party *A*, on coming into offensive contact, can assume an alignment in the fundamental position with greater celerity than the enemy, or can acquire an advantageous initial position.

The interest that the better maneuvering party may have in assuming an alignment different from the normal to the line joining the centers, lies in the probability of leading the enemy into error.

Two cases, then, may present themselves to the better maneuvering party *A:* 1st, the enemy's alignment is not in the fundamental position; 2d, the enemy's alignment is in said position.

In the first case, it is well for the party *A* to assume, on sighting, an alignment equivalent to that of the enemy, changing it at an opportune moment in order to be in an advantageous position on coming into offensive contact.

In the second case, it is clear that the greater the amount of maneuvering, the more *A* can draw advantage therefrom. In other words, it is well for *A* to move toward one of the extremities of the enemy's line, obliging him to maneuver in his turn in order to keep himself in the fundamental position; in this way *A* can make an advantageous entry into the zone of fire. The counter movements of *N* will naturally be inspired by the idea of not allowing the enemy to arrive at firing distance in a superior position; and for this purpose he must have recourse to changes of bearing, keeping the enemy abaft the beam. Under such condi-

tions each of the adversaries will seek, in maneuvering, to lose the least ground possible in the direction of the advantageous course, unless they are so near to the distance for opening fire that they must seek rapidity of evolution above everything else.

On the basis of what has been said, we must hold that unless one of the parties is, to a certain extent, passive, *the phase of contact out of range will be a phase of active maneuvering*, and will produce differences in the initial conditions of position on the establishment of offensive contact. In the following chapter we shall see how this initial situation may affect the tactical maneuvering.

FIG. 34.

57. *Independent Groups in Contact out of Range.*—The breaking up into groups, already alluded to in section 20, appears to be opportune as regards maneuvering, for the following reasons:

1st. The duration of an evolution of a compact fleet is proportional to the length of the alignment, with equality of form of the latter.

2d. By placing the swiftest divisions at the extremities of a line, as has been said in this chapter, the utilization of their speed may be obtained, but only in some special case. In maneuvering by independent groups we may, on the other hand, tend to draw the

maximum return from the maneuvering qualities of each group, in a continuous manner, when each of them is sufficiently homogeneous as regards speed.

Let us now consider the maneuvering of a fleet formed by two independent groups, opposed to a compact fleet, in contact out of range; bearing in mind that we have already recognized the necessity, in offensive contact, of avoiding the echeloning of groups in distance.

The speed of a fleet being determined by that of its slowest unit, it is necessary to distinguish two cases:

I. Each of the independent groups has a speed superior, or at least equal, to that of the party that remains compact.

II. One of the independent groups has a speed inferior to that of the enemy's fleet.

Under the first hypothesis, if the forces that maneuver by groups sufficiently understand each other, so that, although independent, they may rely upon maneuvering in a co-ordinate way, from the maneuvering by groups the abovementioned advantages may really be hoped for, although the enemy maneuvers well. A group will maneuver so as to be at the same distance from the enemy's center as the regulating group, keeping the most opportune alignment according to the rules already established. Although, with regard to the momentary positions, an inferiority of conditions for the compact fleet does not exist—as we have pointed out already—still we must hold that it may result in practice, because the compact fleet is the poorer maneuverer.

In the second case, in order to discover the dangers of breaking up into groups, it is necessary to suppose that the enemy maneuvers in the way that is best for him. Let C_N, C_A' and C_A'' be respectively the positions of the centers of the party N that remains compact, and of the groups A' and A'' into which the party A is divided. The speed V_N of the party N is greater than the speed V_A' of the group A'. From what was demonstrated in Chapter I, it readily results that if N follows a course C_NX, such that the polar bearing XC_NC_A' is equal to or greater than $90° + \text{arc sin } \frac{V_A'}{V_N}$, the distance C_NC_A' continually increases, whatever may be the course of A', because this is the case in which for the slower party, the problem of approach admits of no solution.

This said, it is clear that the course of N may be such as to avoid the approach of A',* producing at the same time the removal of N toward A''.

Under such conditions, if offensive contact is brought about, it will be between the compact party and one of the groups of the other combatant; and in order properly to understand why, in such case, A has not the advantage in maneuvering power alluded to in the hypothesis previously discussed, it is well to reflect that, if the course of A'' is favorable to the approach, the party N, given its presumable superiority with respect to such group, has to trouble itself about the alignment in a much smaller degree than would be required against an adversary of superior or equal strength.

These considerations suffice for concluding:

1st. The necessary condition for breaking into independent groups is that each group shall have a speed not inferior to that of the enemy's fleet.

2d. When the enemy is broken up into independent groups, and one of his groups has a speed inferior to that of our total force, the conduct of our force must be conformed to the rule of moving in the direction of the swifter group, thus avoiding the nearer approach of the slower group.

* The course of N must naturally be established, taking into account the length of the formation; that is to say, it must be the most opportune for the ship that could most easily be approached by A'. (Author's note.)

CHAPTER IV.

TACTICAL MANEUVERS.

58. *Maneuvers in Column of Vessels.*—As has been pointed out in section 48, the fundamental conditions which the tactical maneuvers ought to satisfy are the following: 1st, not to disturb the firing; 2d, allow the immediate and continuous adaptation of the proper maneuver to that of the enemy, each ship imitating the movements of the guide ship as a directive.

It is clear that the simplest tactical maneuver that has the requisites enumerated, and which permits of keeping the fleet perfectly ordered, is the one performed in succession in column of vessels.

For these reasons the importance that is generally attributed to the column of vessels is justified. It is well to note, however, that, conformably to the idea several times repeated, a line of conduct contrary to the spirit of modern tactics and binding one to a fixed formation could be followed; and so, when there is a question of the column of vessels, it is generally to be understood that we do not refer to the ships in that formation keeping the course constant for long intervals, but it is implicitly the idea that the course of the leading ship is generally changeable in a slow but continuous manner, conformably to the standards established for an isolated ship; *hence we refer to maneuvering in column of vessels rather than to the formation of that name.*

Such maneuvering appears the more worthy of consideration inasmuch as the adversaries in the recent Russo-Japanese War confined themselves to it; its importance is incontrovertible, owing to the fact that it requires the minimum amount of preparation on the part of the commander; so that it is indispensable to adopt it when one has at his disposal forces that have had but little drill; but outside of this case, it is well to put the prejudicial question, asking ourselves if the said form of maneuvering is always advisable, so that, admitting its simplicity, we may excuse ourselves from studying other forms.

Against an enemy in column of vessels, the criteria established in section 15 for the selection of ships upon which to concentrate the fire, must be supplemented by taking also into account, besides the firing distance, the disorder that is produced in the enemy's

formation by obliging one ship to fall out of the line rather than another. The advisability of each elementary alignment concentrating its offense on the leading ship of the corresponding division of the enemy rather than on the rear ship is evident, unless, in firing on the rear ship, it is possible to carry on the firing at shorter distances. It is apparent, then, that, *as between two adversaries in column of vessels with courses parallel and in the same direction, the advantageous position must be held to be the one farther advanced in the direction of the course.*

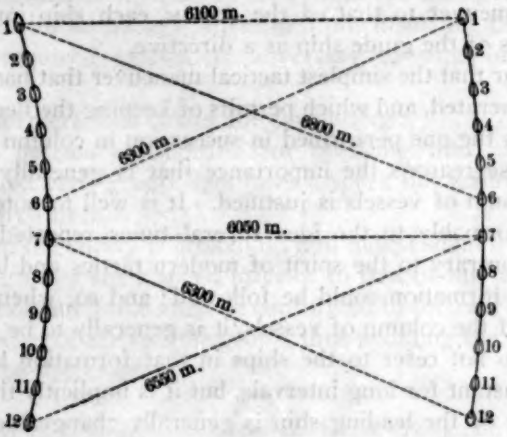

FIG. 35.

Let us consider the hypothesis that the fleets opposing each other, both in column of vessels, have, in offensive contact, alignments in the fundamental tactical position. From what has just been said in regard to concentration, if neither of the adversaries desires to change the distance, they will maneuver in such fashion that their respective center ships may have courses perpendicular to the line joining the centers, and that each may steer in the direction toward which the enemy is moving. Having alignments of the same length, in order to apply this criterion the two adversaries move initially with courses parallel and in the same direction, and the corresponding ships of the two lines will have each other mutually bearing abeam.

If a difference of speed exists between the two adversaries, the swifter party will gain in the direction of the course, thus tending to acquire an advantageous position.

It is evident that each of the two adversaries will seek to maneuver in order to keep itself in the fundamental position. Fig. 35 shows such an object attained; the centers of the alignments have each other constantly bearing abeam. The alignments are, as we already know, concentric circumferences; the ratio of their radii is equal to the ratio of their speed, and the radius of the inner circumference is expressed by $\frac{r}{\frac{V_A}{V_B}-1}$, r being the distance between the centers, V_A and V_B the respective speeds ($V_A > V_B$).

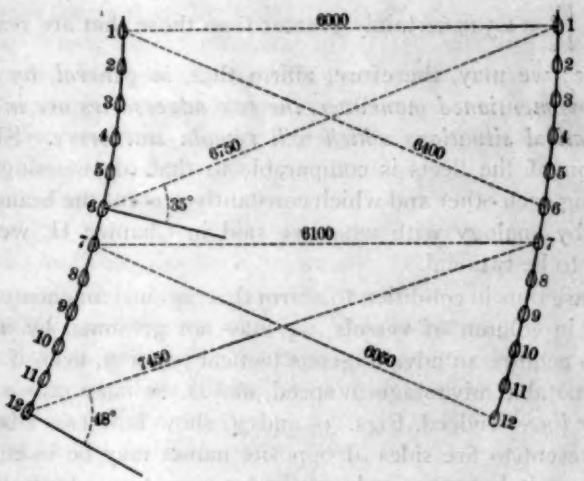

FIG. 36.

The figure corresponds to the hypothesis $r=6000$ meters, $\frac{V_A}{V_B}=1.5$ for the usual interval of 500 meters between ships. As shown by this, the situations of the two adversaries may be considered as equivalent; so much the more so if the speed ratio is inferior to the one supposed.

A situation nearly like the one indicated, and which is often discussed by the students of tactics, is realized when the two leading vessels, steering by sight vane, mutually keep each other bearing abeam; the radii of the circumferences are still those abovementioned, with the difference, however, that in this case r is the distance between the leading ships.

There is thus produced the tactical situation of Fig. 36, which must be held to be advantageous for the swifter fleet for the following reasons: 1st, the center of such fleet is removed forward of the beam of the enemy's center; 2d, the alignment of the said fleet is concave, while that of the other is convex, which causes it to befall that some ship does not present a sector of maximum offense. Such advantages increase with the diminution of the distance and with the increase of the ratio $\frac{V_A}{V_B}$.

With the supposed data, as the firing distances marked in the figure show, the swifter fleet has a sensible advantage; but the value $\frac{V_A}{V_B} = 1.5$ is certainly greater than those that are realized in practice; we may, therefore, affirm that, *in general, by making the abovementioned maneuver, the two adversaries are in equivalent tactical situations which will remain stationary.* Since the situation of the fleets is comparable to that of two single ships opposing each other and which constantly present the beam to each other, by analogy with what we said in Chapter II, we cannot hold it to be rational.

We are thus in condition to affirm that, against an enemy maneuvering in column of vessels, we may not presume, by imitating him, to acquire an advantageous tactical position, even if we possess a notable advantage in speed, *unless we have also a notably shorter line.* Indeed, Figs. 35 and 36 show how two adversaries that present to fire sides of opposite names may be in equivalent positions; it happens analogously between two adversaries who are in fundamental position in column of vessels, with courses parallel but in opposite directions, each of whom changes direction in succession with intent to assume an advantageous position. In this case the alignment of the slower party also turns its concave side to the enemy.

It is readily seen that, for changing the distance, maneuvering in column of vessels is hardly advisable. For such purpose, let us consider the ships of an elementary alignment that concentrate their fire on one of the enemy's ships. In order that the concentration may be possible, it is necessary for the ship nearest the said enemy's ship to have it bearing in a direction near the beam; sufficiently near, at least, to allow the most distant ship to fire in a limit direction of a sector of maximum offense.

Let us refer to what we noted in section 37 concerning the radii of curvature.

If the two adversaries expose to fire sides of opposite names, the radius of curvature of the track described by the party that maneuvers in column of vessels is necessarily very great, and hence the track may practically be considered rectilinear for a segment of a length equal to that of an elementary alignment.

This being the case, solving the triangle formed by the alignment and the two lines joining its extremities with the said enemy's ship, it is perceived that if, for example, the sectors of maximum offense extend to 45° from the beam; the nearest ship must hold the said enemy's ship by sight vane in a direction at least 60° from the longitudinal axis. In such case, *the ships maneuvering in succession in column of vessels are in the condition of a single ship whose sectors of maximum offense do not extend farther than 30° from the beam;* or, maneuvering in succession, one may not generally rely upon controlling the development of the action.

When the two adversaries present to fire sides of the same name, the radii of curvature are greatly reduced; but, even if the concavity of the alignment toward the enemy is sufficient to annul the abovementioned inconvenience, *it does not do away with the fact that the alignment of the party that maneuvers in succession is inclined to the line joining the centers;* while, if the enemy's alignment is in fundamental position, it is obvious that he can oppose changing the distance by opportunely inclining his ships on the alignment.*

* Whoever wishes to study the question in a theoretically more exact way may profit by the knowledge of the following theorem: If two ships steer keeping themselves on constant polar bearings, not only is the indicator of relative movement an equiangular spiral, as we have already had occasion to mention (see note to section 36), but the tracks actually followed by the two ships are also equiangular spirals which are inclined at the same angle with the radius vectors leading from the pole which is common to both. The angle of inclination of the spirals, adopting the usual symbols, is given by the formula

$$\tan i = \frac{V_B \sin \theta - V_A \sin \alpha}{V_B \cos \theta - V_A \cos \alpha}.$$

It results from this that, if one of the two ships is followed by others in succession, the alignment is on an arc of an equiangular spiral.

Lieutenant L. Tonta has occupied himself with this theorem in a valuable article in the *Rivista Marittima* of March, 1901. The question has

Hence, maneuvering in succession may lead to a disadvantageous situation; it lessens the capacity for tactical initiative, because in adopting it *we are obliged to change the alignment, when all that is necessary is a change of course.*

Evidently, the inconveniences of the column of vessels are increased with a composite alignment; that is to say, the greater the number of ships that follow the leading ship.

The advisability of having the ships inclined to the alignment has been alluded to. In general, the idea of keeping the alignment constant for considerably long intervals of time, changing the inclination of the ships to it according to need by means of simultaneous changes of course, does not seem acceptable, because this may permit an adversary who maneuvers in column of vessels to take advantageous positions; this means, opposing a rigid alignment to another eminently flexible; and, for simultaneous changes of course, signals are rendered necessary.

It would, therefore, seem advisable to establish maneuvering in column of vessels as normal, yet not excluding fighting on lines of bearing because of the simultaneous changes of course that may eventually be required; but the defects which we have recognized as attributable to maneuvering in column of vessels lead us to seek a better system.

Maneuvering by simultaneous changes of course presents the aforesaid inconveniences when the changes are intermittent; but we have already alluded (section 17) to a form of alignment (at equidistant positions) which appears susceptible of being maintained in fundamental position; let us seek to develop this idea by procuring the elimination of the inconveniences of maneuvering in column of vessels without falling into that of rigidity of alignment.

We propose to see whether it is allowable to hold as normal the maneuver known as keeping the alignment at equidistant positions, having recourse to the column of vessels as a transitory formation for the evolutions.

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been discussed in France in divers articles published in the years 1875, 1876 and 1880 in the *Revue Maritime;* the results of these studies are set forth in Chapter II of *Manuel pratique de Cinematique navale* by Comdr. L. Vidal (1905). In practice, however, for the length of the alignment, the equiangular spiral may be considered as an arc of a circle the radius of which is given by formula (11) of Chapter I. (Author's note.)

Such importance as a transitory formation may be admitted without further argument, observing that, if it is necessary notably to change the alignment, the evolution must be such as not to render perilous the effects of an erroneous prevision of the tactical situation at its end; or, at such a moment, it is best to be in column of vessels. *The evolutions that we must examine for the change of alignment in offensive contact are thus reduced to that performed in succession and those based upon wheeling the column of vessels* (section 53).

59. *Maneuvering at Equidistant Position.*—By virtue of what we said in section 17, an elementary alignment opposed to another may practically be considered an arc of a circle having its center at the center of the enemy's alignment, when, an extreme ship

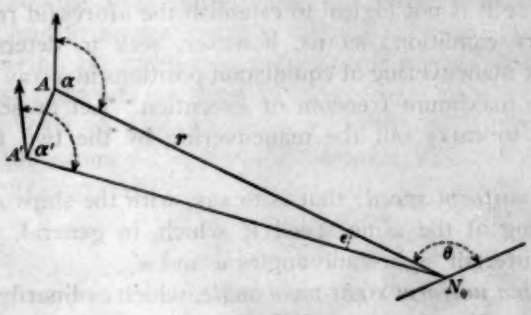


FIG. 37.

being taken as the regulator, every ship is in a position such that the angle between the line joining it with the adjacent ship in the direction of the regulator and the line joining it with the aforesaid enemy's center, is 90°.

Supposing the ships to be on such an alignment, we propose to study the maneuvering that permits of maintaining it.

Let us consider two adjacent ships A and A' (Fig. 37) of an alignment at positions equidistant from N_0, having as a radius the distance r; the angle $AA'N_0$ being 90°. Let us indicate by d the distance AA' and by ϵ the angle AN_0A'; we then have

$$\sin \epsilon = \frac{d}{r}.$$

Let α and α' be the polar bearings on which, at the instant under consideration, the respective ships A and A' hold N_0; these bearings being counted from the bow. If θ is the polar bearing on

which A is held by N_0 (counted from the stern), the analogous bearing for A' could be $\theta+\epsilon$ or $\theta-\epsilon$. We will indicate by V, V' and V_N the respective speeds of A, A' and N_0.

Let us note first of all that if there exists the relations

$$V \sin \alpha = V_N \sin \theta,$$

the indicator of movement of A with respect to N_0 is given by the joining line AN_0; and hence, in order to preserve the alignment in the fundamental position, the ship A' (and, more in general, the ships of the alignment opposed to N_0) must keep the course and speed of A.

While not excluding the possibility that the conditions just mentioned may be realized in practice, it is readily seen that this method *with uniform speed and course* cannot be held to be general, because it is not logical to establish the aforesaid relation as a necessary condition; let us, however, seek to determine the criteria for maneuvering at equidistant positions in a way that may permit the maximum freedom of execution. Let us see if it is acceptable to carry out the maneuvering by the two following methods:

1st. *At uniform speed;* that is to say, with the ships A and A' maneuvering at the same speed V which, in general, naturally requires different sight-vane angles α and α'.

2d. *With a uniform sight-vane angle,* which ordinarily requires that the ships A and A' have different speeds V and V'.

In both cases the ships of the A party must move in such a way that, in the time dt, they may have the same change dr in the distance from N_0. If we wished to calculate the unknown values α' and V' it would then suffice to apply the fundamental tactical relation. Thus, for the method at a uniform speed, we have

$$V_N \cos \theta - V \cos \alpha = V_N \cos(\theta \pm \epsilon) - V \cos \alpha'. \qquad (1)$$

Naturally, when the value of $\cos \alpha'$ supplied by this formula is not, in absolute value, less than unity, it means that the method is not applicable.

For the other method, in the foregoing relation it would be necessary to put $V' \cos \alpha$ in place of $V \cos \alpha'$; in other words, we may say that the value of V' must satisfy the condition

$$V' \cos \alpha = V \cos \alpha', \qquad (2)$$

wherein it is necessary to introduce the value of $\cos \alpha'$ obtained from (1).

Applying these methods, evidently the distance AA' does not remain invariable.

In order to fix these ideas, let us consider the simplest hypothesis, which is that of a stationary enemy. Putting, in formula (1), $V_N=0$, we have $a'=a$; which, introduced into formula (2), gives $V'=V$; hence, in the particular case to which we now refer, the two methods just mentioned are combined, the ships being able to maneuver with uniform speed and sight-vane angle. Against a low fort, or a ship at anchor, such maneuvering may be opportune, because it permits the ships of a homogeneous division to keep the enemy bearing in a direction of maximum utilization.

We may, then, in a very simple way, extend the rules established for maneuvering an isolated ship to the maneuvering of a division; because such rules, in the case of a stationary enemy, evidently lead to maneuvering at a limited distance, keeping the enemy bearing in directions of maximum utilization alternately forward of and abaft the beam.

In such case the joining lines AN_0 and $A'N_0$ both revolve through the same angle, because formula (10) of Chapter I (section 37), becomes

$$\frac{d\sigma}{dt}=\frac{V\sin a}{r}.$$

The angle ϵ under which the ships A and A' are seen from N_0 thus remains invariable; therefore, when the radius of the equidistant alignment passes from a value r_1 to a value r_2, the distance AA' changes from a value d_1 to d_2; and there is realized

$$\frac{d_1}{r_1}=\frac{d_2}{r_2};$$

both the members of the equation being equal to sin ϵ. Consequently, if r_1 and r_2 are respectively the superior and inferior limits between which it is predetermined to maintain the distance from the enemy N_0, when the maneuvering is begun at the superior limit of the fighting distance it is necessary that the distance d_1 between ships be established as somewhat greater than the allowable minimum, remembering that during the maneuvering it will be reduced to d_2. When, as generally happens, the ratio $\frac{r_2}{r_1}$ is not inferior to $\frac{7}{10}$, it might seem opportune to establish for d_1 the value that is ordinarily assumed as the normal; and this in conformity with what is said in the preceding chapter concerning

the diminution of the distance allowable during the evolutions. It is clear, however, that in every tactical maneuver this tolerance may obtain within narrower limits; thus, in the special case that we are considering, it is necessary to remember that, at the instant at which the ships find themselves at the minimum distance, they must execute a simultaneous change of course in order to bring the enemy to bear abaft the beam; it is, therefore, well to establish that the normal distance between ships shall be realized for the mean distance $\frac{r_1+r_2}{2}$ from the enemy, rather than for the maximum distance r_1.

For example, supposing the limits between which it is desired to keep the firing distance to be 10,000 meters and 7000 meters, and the normal distance between ships to be 500 meters; to the end that the latter may correspond to the mean distance (8500 meters) from the enemy, it is necessary for the ships, when they begin the action at the distance of 10,000 meters, to have an interval between them of 600 meters; and, by reason of the maneuvering, at the limit of the approach it will be 400 meters; which will always be sufficient.

Such an amount of oscillation (100 meters more or less than the normal distance) is allowable even against an enemy's fleet in motion; and in fact it is well to observe: 1st. That, theoretically, every increase in length of the alignment constitutes a disadvantage of position; however, as we have already observed in Chapter III of Part I, if the difference in length between two opposing alignments is 500 or 1000 meters, it may be held to be negligible in practice, because only a small part of it affects the conditions of position. 2d. The normal distance between ships must of necessity be established as somewhat greater than the minimum which confers safety of maneuvering.

Without doubt, then, we may affirm that, having regard to maneuvering at equidistant positions in the general case of an adversary in motion, it is well to be governed by the following rules: 1st, watch the variations of the distance between ships, with the understanding that these variations are to be kept within sufficiently narrow limits; 2d, it is well that the distance between ships at the limit of offensive contact should be somewhat greater than the normal.

This being established, we make the following reflections:

The method at uniform speed is naturally that which at first sight appears to be preferable; but it may possibly lead to varying the distance between ships beyond the desired limits. On the other hand, the method with a uniform sight-vane angle might require a ratio $\frac{V'}{V}$ differing too much from unity.

Let us note that, for the maneuver in question, the ship A', in order to keep the speed V, should keep N_0 bearing at an angle α', while the polar bearing α would correspond to the speed V'; hence, to a bearing α_1 intermediate between α and α', there will correspond a speed V_1, intermediate between V and V'; or, the ratio $\frac{V_1}{V}$ will be nearer to unity than $\frac{V'}{V}$.

We recall further that, while the ship N_0—from which it is desired to keep the ships of the alignment at equidistant positions—is the one that occupies a central position in the enemy's alignment, the ship upon which ordinarily it is best to concentrate the offense, is an extreme ship of the said alignment. It results from this that the extreme ship of our own alignment, which serves as a regulator, must keep the enemy's ship for the concentration of fire at an opportune sight-vane angle which will be established according to criteria of which we will shortly speak; the polar bearing of N_0 will be the one which will derive as a consequence of this. If, thus far, we have referred to the polar bearing of N_0, it has only been for the sake of simplicity of reasoning.

The criteria sought for the execution if the maneuvering at equidistant positions may be established in the following manner.

Let us suppose our alignment to be in the fundamental position, and that the ships have all the same course, so that they are on a line of polar bearing. An extreme ship, taken as a regulator, keeps the enemy's ship for the concentration of fire on an opportune bearing, and, more in general, maneuvers, with respect to the said enemy's ship, in a way conformable to the criteria determined upon in the study of the naval duel; thus describing, generally, a curvilinear track with a great radius of curvature.

Each ship continually imitates the movements of the adjacent ship in the direction of the regulator in such fashion as to keep itself in the position from which may result the angle of 90° between the line joining it with the said adjacent ship and the one joining it with the center of the enemy's alignment. With such

object it may slightly modify its course with respect to the adjacent ship, but within a limit that does not produce too notable variations of distance. Such limit being reached, it is best for the said ship to vary the speed in order to preserve the desired position.

Briefly, it may be said that *a ship must imitate the movements of the adjacent ship; that is, keep on a course about parallel to it, slightly modifying its course and speed in order to satisfy the 90° rule.*

Thus *the way to carry out the maneuvering at equidistant positions is by the fusion of the methods before alluded to.* It is evidently well to ordain that the regulating ship be the inner one on the side of the changes of course necessary for steering by sight vane, and it is generally advisable for the said ship to maintain a speed slightly inferior to the normal speed,* to the end that the maneuvering may be facilitated for the other ships; or, in order to increase their reserve of speed. It is possible that the reserve of speed of the other ships may not be sufficient for maintaining the alignment in fundamental position; nevertheless, it is easy to see that the most rational criterion for maneuvering remains as abovementioned; indeed, in such case, although not fully attaining the object of keeping the alignment in fundamental position, we approximate to it as nearly as possible.

If the regulator ship develops the maximum speed, the application of the prescribed rule causes the ships to change course in a continuous way parallel to it; *and the formation becomes a line of polar bearing, in which, however, the bearing may be slowly variable,* the ships executing continuous but very slow changes of course with a great radius.

*As has been said in the preceding chapter (section 49), the normal speed is inferior to the evolutionary speed which is generally the maximum speed of the slowest unit. When the alignment is changed by wheeling the column of vessels, it is necessary for the pivot ship to reduce its speed to one-half of the evolutionary speed; but, in the case of maneuvering at equidistant positions, the reduction of the speed of the regulator ship must be kept within restricted limits, enabling the speed to be maintained. In like manner to that of limiting the reductions from the maximum to a speed inferior by four or five knots—established for the naval duel—it is well to ordain that the speed of the regulator ship in the maneuvering under consideration shall not fall more than three knots below the normal speed. (Author's note.)

Let us now consider a composite rectilinear alignment; that is to say, two contiguous elementary alignments placed one on the prolongation of the other, or an angular alignment. It is clear that, in each elementary alignment, it must be sought to maneuver at positions equidistant from the enemy's corresponding alignment. One of the elementary alignments acts as a regulator; and the extreme ship of the other alignment, adjacent to the outer ship—with respect to the change of course—of the regulator alignment, imitates the movements of the latter, modifying its speed in the manner most opportune for the object that it is desired to secure.

From the foregoing we may conclude:

1st. The tactical maneuvering to be held as normal is that at equidistant positions; there results from it a flexible alignment, capable of being adapted in a continuous manner to the changeableness of the tactical situation, without disturbance to the firing.

2d. The said maneuvering admits, as a particular case, having a *constant alignment*, in which an extreme ship steers with the sight vane on an enemy's ship, and the others imitate its movements, tending to keep the courses parallel.

3d. The type of maneuvering just indicated presents no dangers, the inner ship on the side of the changes of course being chosen as the regulator, and the said changes being with a great radius resulting from steering by sight vane.

60. *Inclination of the Ships to the Alignment.*—Let us now see what conditions must be satisfied by the inclination of the ships to the alignment, to the end that it may be possible to concentrate the fire, while presenting the ships in the most opportune manner as regards offensive as well as defensive conditions.

Let N_1 (Fig. 38) be the enemy's ship on which it is desired to concentrate the fire, and A_1A_2 an elementary alignment at positions equidistant from the center N_0 of the enemy's alignment which, in the figure, is supposed to be in the fundamental position; but which, naturally, could also be inclined with respect to the line joining the centers.

For the determination with which we are now occupying ourselves we may hold that the various ships of A_1A_2 have about the same course. The ship A_1, which is at the extremity of the alignment nearest to N_1, desires to bring that ship to bear in a limit direction of a sector of maximum offense; it might do this by hav-

ing its longitudinal axis * in the direction XX' or in the direction YY'; XX' and YY' being symmetrical with respect to N_1A_1.

It is clear, however, that, in the case of YY', the other ships of the alignment would have N_1 bearing in a sector of minimum offense; while if the longitudinal axis of A_1 is in the direction XX', the other ships can have N_1 bearing in a direction inside of a sector of maximum offense. Naturally the bows of the party A must be in the direction A_1X, or in the direction A_1X', according as A desires to bring the enemy to bear abaft or forward of the beam; hence it is well to reflect that, considering the sea plane to be divided into two parts by the alignment, *the bow must be toward the side away from the enemy when he is to be brought to bear abaft the beam, and toward the side next to the enemy if he is to be brought to bear forward of the beam.*

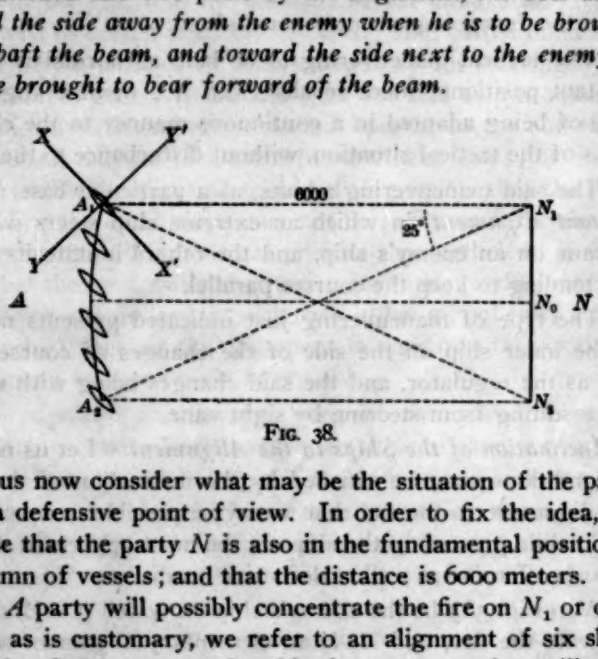


FIG. 38.

Let us now consider what may be the situation of the party A from a defensive point of view. In order to fix the idea, let us suppose that the party N is also in the fundamental position, but in column of vessels; and that the distance is 6000 meters.

The A party will possibly concentrate the fire on N_1 or on N_2; and if, as is customary, we refer to an alignment of six ships at intervals of 500 meters, the ship for concentration will receive the offense in a sector of about 25° *couting from the beam.*

This being the case, let us suppose that the ships of the A party have sectors of maximum offense with amplitudes of 45° forward of and abaft the beam; if N concentrates his fire upon A_1, that ship will receive the offense in a sector included between directions

* In referring to the longitudinal axis we consider indifferently the hypothesis that N_1 is kept forward of the beam, or that it is kept bearing abaft the beam. (Author's note.)

that form angles of from 20° to 45° *with the longitudinal axis;* if, however, the fire is concentrated upon A_2, that ship receives the offense between directions that form angles of from 20° to 45° *with the beam.* This example suffices to show that it may be advantageous to present the ships inclined to the alignment; the more so as, within the limits of distance at which it is specially advisable to concentrate the fire (section 14), the angle $A_1N_1A_2$ will have a value smaller than the one under consideration.

In case of the distribution of the fire it is seen a fortiori *that it may be advantageous to present the ships inclined so that each ship may have its corresponding adversary bearing in a direction of maximum utilization.*

It is to be noted that, when the *A* ships have sectors of maximum offense that extend 60° forward of and abaft the beam, if the regulator ship has N_1 bearing in a limit direction of a sector of maximum offense—that is to say, only 30° from the longitudinal axis—it is possible that some ships will be exposed to enfilading fire; which presents no disadvantages at the maximum firing distances (as is said in Chapter I, Part I), but is ordinarily to be avoided. Hence it may generally be established that *the polar bearing on which the regulator ship keeps the nearest enemy's ship by sight vane, must bear some relation to the way in which the enemy's alignment is inclined to the line joining the centers, as well as some relation to the criteria concerning the direction of maximum utilization.*

61. *Evolutions in Simple Alignment.*—For offensive contact we have established the necessity of having as little recourse as possible to evolutions; without, however, excluding the possibility of being obliged to do so in case one cannot succeed in keeping the alignment in a position sufficiently near the fundamental position.

As has already been noted (section 58), the proper methods for changing the alignment are limited to that performed in succession and those based upon wheeling the column of vessels. *In general, it is well to give the preference to the first method on account of its greater simplicity, and, owing to the possibility of changing an evolution in progress, adapting it to the counter movement of the enemy.* It results from this that the other methods abovementioned can usefully be employed in particular cases, when it may be expected to secure with them the desired objects in a considerably shorter time than would be required by

the evolution performed in succession; and this without too greatly disturbing the firing.

In executing the wheel with the speed ratio $\frac{1}{2}$ conformably to the conclusions of section 33, IV, in order to have an advantage in rapidity over the evolution performed in succession, the angle ω, through which it is desired to change the alignment, must be less than 30°, or than 60° according as the pivot is the rear ship or the leading ship. When pivoting on the ship about one-third from the head of the column—as results from the table in section 53—there is also an advantage in rapidity when ω reaches 90°.

From what has been said in this chapter, the ships will generally be inclined to the alignment. The evolution of section 53, II (which can be executed by pivoting on the rear ship or on the leading ship) permits of forming a column of vessels inclined at the angle ω to the actual alignment, without need of changing course together on the said actual alignment in order afterward to execute the wheel.

If the angle ω is within the limits above recorded, *and if the course is sufficiently near the one required for the evolution, within a limit such as to permit one to expect but little disturbance to the firing,* the evolution, pivoting on the rear ship, is advisable if the course inclines toward the new alignment, or on the leading ship if the course inclines in the opposite direction. In other words, if α is the polar bearing of the formation, it is necessary that the difference $\phi_c - \alpha$, or the other difference $\alpha - \phi_t$, be sufficiently small; ϕ_c and ϕ_t indicating, as usual, the angles corresponding to ω given in the table for wheeling the column.

When the circumstances just mentioned are not realized, the course may be changed on the alignment, thus resulting in a column of vessels, and the wheel executed afterwards, pivoting at about one-third from the head of the column; in this way a gain in rapidity may be had, but the situation will often counsel its abandonment because the said advantage will be negligible when compared to the inconvenience resulting therefrom. The English writer several times cited expresses himself in this connection in the following manner: "Wheeling a column of vessels is undoubtedly an efficacious method of changing the direction of a long line in the quickest way possible; but reflecting upon the disorganization that such a change brings upon the firing of a squadron, it must be used with extreme caution."

Moreover, in prescribing the angle through which the alignment

is to be changed by wheeling, it is necessary to keep in mind the probable counter-movement of the enemy; not taking this into account, there might be attributed to the methods by wheeling a greater importance than they really have; while, in practice, such importance is very limited.

We propose to fix these ideas by considering how such illusions may arise.

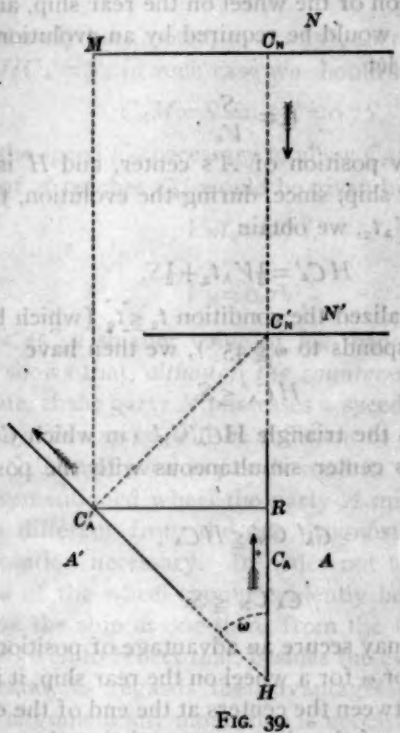


FIG. 39.

Let us suppose that the fleet A (Fig. 39) finds itself in the worst possible position; that is, the enemy N has succeeded in crossing the T, and that he has taken a course parallel and opposite to that of A with the object of maintaining his advantage of position and drawing the maximum profit therefrom by diminishing the distance. Let us indicate the speed of the A party by V_A. If this party wheels his alignment through ω, pivoting on the rear vessel, the new inclination Ω of A's alignment to the line joining the centers is greater than ω. We have already called attention to

this in section 53 and observed that in contact out of range the difference $\Omega - \omega$ is of small importance; but it is understood that if the distance diminishes beyond a certain limit, the angle Ω may become about 90°, ω still being within the limits before mentioned. Let us seek the conditions of distance necessary in order that we may have $\Omega = 90°$.

Let S be the length of A's alignment, and let us, as usual, indicate by t, the duration of the wheel on the rear ship, and by t_0 the length of time that would be required by an evolution in succession; that is to say, let

$$t_0 = \frac{S}{V_A}.$$

If C_A' is the new position of A's center, and H is the initial position of the rear ship, since, during the evolution, the track of the pivot ship is $\frac{1}{2}V_A t_2$, we obtain

$$HC_A' = \tfrac{1}{2}V_A t_2 + \tfrac{1}{2}S.$$

When there is realized the condition $t_2 \leqq t_0$ (which by the table in section 33 corresponds to $\omega \leqq 45°$), we then have

$$HC_A' \leqq S.$$

When $\omega \leqq 45°$, in the triangle $HC_A'C_N'$ (in which C_N' indicates the position of N's center simultaneous with the position C_A'), we have

$$C_A' C_N' \leqq HC_A',$$

or

$$C_A'C_N' \leqq S.$$

In order that A may secure an advantage of position within the limits established for ω for a wheel on the rear ship, it is necessary that the distance between the centers at the end of the evolution be less than the length of the alignment; *and that the course of the party N be kept unchanged.*

Given that the distance is within such limits as not to exclude the possibility that A may attain his object, if the party N answers by making a simultaneous change of course so as to move in the same direction in which A executes the wheel, thus bringing itself into column of vessels, the party A, at the end of the evolution, will find itself in a situation very different from the one imagined. In fact, setting aside for both the adversaries the time required for the changes of direction, let us suppose that N's change of direc-

tion is made at the same instant at which A begins the wheel; the party N, at the end of the time t_2, would again be in fundamental position when its center should arrive at a point M, such that $C_N M C_A' = 90°$. Now, drawing $C_A' R$ parallel to $C_N M$, from the right-angled triangle $C_A' RH$, which is right angled at R, we have

$$RC_A' = C_N M = HC_A' \sin \omega.$$

As has already been noted, to $\omega = 45°$, there would correspond $t_2 = t_0$ and $HC_A' = S$; in such case we should have

$$C_N M = S \sin 45° = 0.7S,$$

and hence the speed V_N necessary to allow C_N to arrive at M when the center of A reaches C_A' would be given by

$$V_N t_0 = 0.7S,$$

or

$$V_N = 0.7 V_A.$$

When $\omega < 45°$ a smaller value of V_N than this would be sufficient; this shows that, *although the counter-move of N may not* be immediate, if the party N possesses a speed about equal to that of the enemy, this speed will be sufficient to permit C_N to arrive on the line $C_A' M$ and even to pass beyond it. So, then, at the end of the abovementioned wheel the party A might be in a relative position so different from the one prognosticated as to render another evolution necessary. In order not to run such risk the amplitude ω of the wheel should evidently be 90°, and the pivot should be on the ship at one-third from the head of the column. But it is also well to reflect that, besides the evolutionary rapidity, it is important, as regards the advantages of position, not to change the alignment any more than is necessary; for this reason, everything considered, it seems that in the case in question the evolution performed in succession would be preferable for A, unless the extreme ships are very swift.

As is well known, in simultaneous changes of direction, every ship must wait for the movement to be begun by the adjacent inner ship on the side toward which the change is made; for this reason the changes of direction that are called simultaneous are practically successive changes at very short intervals of time. Conformably to this, in order to execute such changes with the maximum promptness, it is to be borne in mind that the inner

ship on the side toward which the change is made can haul down the signal and begin the movement as soon as the signal is repeated by the adjacent ship.

A particular case worthy of consideration is that of a fleet in column of vessels that desires rapidly to invert the course. It is not impossible that this may be required in order to stop an abrupt movement of the enemy, as happened to the Japanese at the battle of Tsushima. In such case the simultaneous change of direction would contemporaneously disorganize the firing of the whole fleet; therefore, the example of Togo is to be imitated by making the ships of each division change together, and the divisions change in succession so that, during the movement, one division remains protecting the other with its fire.

62. *T Positions.*—To the criteria established for the conduct of a fleet in a simple alignment in offensive contact it is well to add a few observations directly regarding the object that the maneuver must have in view.

I. It is incontrovertible that the ideal object would be that of crossing the *T;* but with two compact fleets it is obvious that this cannot be accomplished, no matter how small the maneuvering qualities of the enemy may be. Therefore, it is not necessary to sacrifice the maneuvering in the least in order to tend toward this ideal. The *immediate* tactical situation must be kept in view, seeking above everything else to maintain oneself in fundamental position while still tending toward crossing the *T*. Very small importance should then be attributed to the study of maneuvers based upon a preconception of passive conduct on the part of the enemy. Let us give an example of this.

Supposing two adversaries in column of vessels, if one of them keeps the course unchanged, then the other, possessing greater speed and his column leader steering with a certain sight-vane angle, can reach a sector of minimum offense of the enemy's fleet. Given the speed ratio and the limits within which it is desired to keep the variation of the distance, the opportune sight-vane angle might be graphically deduced and the various angles afterwards registered in a table, the practical importance of which we may value with the following consideration.

It is not impossible that, by concentrating the fire on the leading ship of the enemy's line, we may deprive the said line of its chief; for this it would be necessary that the flagship initially lead the line; that, the commander-in-chief being dead, the signal trans-

ferring the command be not seen; and that the commander of the leading ship, being without orders, should keep the course unchanged, as happened at the battle of August 10, 1904. But this is a very particular case, and it is logical to believe that the enemy will so act as to avoid it, considering this hypothesis to be among those generally prescribed for tactical contact. Then, the maneuvering commenced with the sight-vane angle supplied by the table would not answer to any rational conception; rather, it is easy to believe that the table would be a useless shackle, even in case the enemy should behave in the aforesaid passive manner, because, the maneuvers inspired by the criteria generally admitted in the preceding sections would answer better.

II. From what has been said in the preceding chapter (section 56), it is to be predicted that, at the beginning of offensive contact, the positions of the two adversaries will not be tactically equivalent; it is even not illogical to affirm that, while generally excluding the probability—as has just been observed—that the ideal crossing of the T may be completely secured, it will be at the initial moment that it will be possible to approach that ideal.

In order to fix the idea, let us note that, at Tsushima, the fleet of Togo, finding itself forward of the enemy's beam at the moment of sighting him, if it had steered on a line of bearing directly on the course of the latter, it would presumably have been able to establish offensive contact in a more predominant position than the one obtained with the inclined course and with the formation in column of vessels.

So, then, the example of the preceding section shows that if one of the adversaries is in an advantageous position, the evolution of the enemy intended to establish superiority or at least tactical equivalence, will hardly completely attain its object, it being very easy to execute the counter-movement to such an evolution; on the contrary, if instead of supposing—as in the said example—that the party N, after having crossed the T, has taken a course parallel to that of A, we imagine that it maneuvers according to the criteria deduced in section 59, the counter-movement to A's evolution might not always be necessary. In such case it is true that A might succeed in assuming an equivalent alignment; nevertheless, even when this is reached, the ships of A, being in column of vessels, will not find themselves in the best defensive conditions, and it will still remain to them to execute a simultaneous change of direction, with disturbance to the firing, in order effectively to

establish conditions of equivalence; while the ships of *N* will have been all the time in the best possible conditions from the offensive and defensive points of view. For this reason, and on account of the difficulty of properly estimating the variability of the tactical situation during the evolution, it is to be presumed that some portion of an advantage of position will always remain; and if we bear in mind, as already noted in section 25, that the advantages obtained produce a compound effect, that victory is the integration of small advantages, each one of which, separately considered, might seem negligible, we must recognize *the great importance to be attributed to the initial tactical situation.*

III. Having had the good fortune to cross the *T*, in order to maintain the relative position with respect to the enemy, it is necessary to change to a parallel course; but it seems logical to limit this rule to cases in which its application does not imply a sacrifice of offensive power. In fact it is not presumable that the enemy will not maneuver to extricate himself from his critical position, and hence, proposing to oneself the object of maintaining the position with a sacrifice of offensive power, although the latter may prove to be all sufficient, would seem to be aiming at an illusory object, to obtain which one will find himself obliged to execute two changes of course at very short intervals of time. Thus, having crossed the *T* with respect to a fleet in column of vessels, if one were to change his course, one-half of his principal armament would quickly go out of action. Let us suppose further that in this way one might remain in the advantageous position for a time double that which would remain to him when developing the maximum offensive power; the minor duration of the advantage would be compensated in the second case by the greater total result. For the rest, under the wild hypothesis that the enemy does not maneuver, one might keep himself in the sector of minimum offense of the enemy's alignment, still developing the maximum intensity of fire; indeed, it would suffice to execute an opportune change of course on arriving in proximity to the limit of the aforesaid sector.

63. *Maneuvering on a Double Alignment.*—It is well known that the experiments carried out in France with the already mentioned Fournier system of tactics, have brought to light the inconveniences of the double alignment in offensive contact.

The illustrious admiral proposed to himself, by dividing the fleet into tactical units each formed by three ships, to obtain great

manageability by virtue of the shortening of the line. For this purpose, the group-leading ships, as well as the units composing such groups, must not be held rigidly bound to the formation, but must move opportunely on their own initiative in order to secure the best utilization of the guns. Nevertheless, in practice, the ships of the outer line, obliged to fire at targets that present themselves between friendly ships, cannot always be in the desired position; *frequent changes of the target constitute the inevitable inconvenience of the double alignment.*

On the other hand, in the preceding chapter (section 55), it has been made evident that such a form of alignment has scant evolutionary capacity; or, the manageability deriving from the shortening of the line is only apparent. In order to tend toward this object it might be prescribed that the distance between ships could be shorter than that held to be necessary for the simple alignment; but there would then result a limitation of the movements, it being necessary to abandon simultaneous changes of course; and the anxieties of maneuvering would be increased.

Finally, as we have already noted in Chapter II of Part I (section 11), the launching of torpedoes for the maximum run against a fleet, while it is not rational if the enemy's alignment is a simple one, may have a probability of success against a fleet in two lines.

For these reasons we hold that, unless we have a very numerous fleet, the adoption of the double alignment is to be restricted to cases in which we ought to utilize in the second line any antiquated ships, limiting their number, however, as is set down in section 56.

64. *Maneuvering by Independent Groups.*—Let us suppose a fleet broken up into groups each one of which has a speed not inferior to that of the enemy's fleet; that is to say, the condition recognized in section 57 as necessary for obtaining a good initial situation is satisfied.

It is true, as we noted in section 20, that the compact fleet, by assuming an opportune angular alignment, may bring itself into conditions of equivalence with respect to the enemy that is divided into groups; it is obvious, however, that, in practice, it will not succeed in obtaining these conditions continuously, because the divisions of the compact fleet cannot always satisfy the double condition of keeping together, and having, each one of them, an alignment in fundamental position with respect to the corresponding group of the enemy, besides having the ships in-

clined to the alignment in a way suitable for the development of the maximum offensive power. The tactical government of the compact fleet will have to satisfy too many conditions, owing to which the said compact fleet will be notably a poorer maneuverer than the enemy.

The advantage of maneuvering by groups being derived from this idea, it is clear that such advantage will be maximum when one of the groups is composed of a few ships (not more than six) endowed with very high speed. The maneuvering of this division, called the *flying squadron*, must be developed in a way such as to produce the maximum rapidity of rotation of the line joining it with the adversary; then it is to be presumed that it can enter a sector of maximum offense.

The number of ships of the flying squadron having to be limited, as has just been said, it appears to be clear that it is important that each of these ships should have a powerful armament. The type adapted to such a purpose is then that of a very swift armored ship, with a speed of at least four or five knots greater than the types that are constructed for composing the principal squadrons, with a powerful armament, and with the best protection possible subordinately to the development of the offensive capacity and the mobility.

From what has already been established, the flying squadron must generally be kept at the same distance from the enemy as the principal squadron; but when the distance falls near to the lower limit of the mean distance (3500 meters) a closing in maneuver by the flying squadron is not to be deemed rash, trusting that if the enemy commits the error of maneuvering to engage with the said group, he will place himself in conditions of inferiority with the opposing principal squadron. If, on the other hand, this were attempted at a greater distance, given the time that would be required for a considerable approach, the flying squadron would risk being overpowered.

Conformably to what we have set forth in section 62, III, the flying squadron must not sacrifice the development of the maximum offensive power to the maintenance of a *T* position.

65. *Maneuvering at Close Quarters.*—We now propose to see how the criteria established in section 46 for the maneuvering of a single ship within the limits of a fight at close quarters may be extended to a fleet of ships. Even if, as is to be presumed, the

two adversaries do not maneuver with the principal object of ramming, they must run to meet each other.

For convenience of reasoning, let us begin by considering the hypothesis that a group composed of several ships is fighting an isolated ship; and let us ask ourselves the following question: Given that the ships of the group desire to ram the enemy's ship, what could be the formation and the most opportune maneuver?

Let us observe that it would be exceedingly dangerous for the ships of the group to execute a maneuver which might have for its object the concentration of the rams; we mean by this that if, for example, the ships of the group are two, *A* and *B*, disposed in line abreast, and if the enemy's ship *C* steers for the center of their formation, the two ships *A* and *B* cannot attempt simultaneously to ram *C* without risking ramming each other. In other words, *A*, for example, can head for *C*, and *B* must change course parallel to *A*; while *C*, in so far as the ram is concerned, will in this way have to do with but one ship.

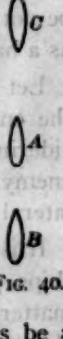


FIG. 40.

This simple fact must be kept in mind because it shows that any maneuver based upon the concentration of the rams must be abandoned; and that, instead, for the employment of these weapons, it is necessary to base it on successive action. In order that the action may assume this second form, the formation of the group must needs be a deep one; *consequently the column of vessels may be considered as the fundamental position.*

The column leader of the group steers for the enemy's ship; the two ships pass close to each other; the second ship in the line maneuvers with respect to the enemy without troubling itself to follow the column leader in succession, and so on.

It is here necessary to observe that the conditions of the ship that fights with the group grow worse the greater is the depth of the latter's formation, up to a certain limit. With this we desire to refer, not only to the greater number of ships that successively attempt to ram, but also to the offensive returns of the same. Since, indeed, within the limit of their close approach, each ship has the maximum interest in keeping the bow on the enemy, the ship *A* (Fig. 40), after passing *C*, turns with the helm hard over so as to come again to a meeting with *C;* and, analogously, *C* would wish to turn also, but cannot do so on account of *B*, who imitates the maneuver performed by *A*. The ship *C* is hence

prevented from inverting the course, and consequently finds itself in a condition of grave inferiority with respect to *A*, unless it has more speed or possesses better evolutionary qualities. The group is so much the better disposed for this purpose the more the depth of its formation approaches that necessary for giving *A* a notable advantage with respect to *C* in the inversion of the course. It is understood that in increasing the depth of formation beyond a certain limit, the advantage ceases to exist.

Passing from the particular case considered to the more general one of two groups on the basis of the ram only, it results from this that a group that moves in line abreast against another in a formation nearly approaching that of a column of vessels, is in an inferior position; it suffices that the ships of the latter group be not bound to maintain the formation, but may consider it only as a basis for the maneuvering.

Let us now see what conclusions may be reached in relation to the employment of the torpedo. We begin as usual with considering the hypothesis of a group of ships that attack a single enemy's ship; both the adversaries are supposed to be armed with lateral launching tubes.

It is easily seen that the group must do its best to have its own ships pass successively on the same side of the enemy. As a matter of fact, if the group is composed of two ships, it will be able to use its torpedoes as well if the enemy's ship passes between the ships of the group, as if it leaves them both on the same hand; but in the first case (which is that in which the ships of the group are not in column of vessels) the group permits the enemy to put forth his maximum offense by launching torpedoes from both sides. For this reason it is obvious that the first method of action is preferable, even when the ships of the group are more than two.

At this point the object of the maneuvering of the group appears to be thus determined: *To pass by on the same side of the enemy's ship.* The maneuvers should then be about that in column of vessels and in succession. Inversely, the ship that fights the aforesaid group should maneuver so as to pass between the ships of that group.

Let us now suppose the two groups to be equally armed with torpedoes, and let us imagine that the first has a front formation, and the other a deep formation. For example, let four be the number of ships composing each group, and let us indicate by

A, B, C, D (Fig. 41) the ships of the first group, and by A_1, B_1, C_1, D_1, those of the second.

If, in order to consider a special hypothesis, we imagine the first group to be formed in a square and the second in column of vessels, as shown in the figure, it is evident that, as regards the torpedo, the group A_1, B_1, C_1, D_1, during the passage by, will be in better conditions than the other, because it can fire twice the number of torpedoes.

As the same reasoning might be repeated for formations analogous to those considered, we may affirm that the object of the maneuver in battle at close quarters, must, with regard to the use of the torpedo, be that of obliging the enemy's ships always to present the same side in passing by; and inversely, each ship, bearing in mind the object just mentioned, must seek to pass between the enemy's ships so as to launch the greater number of torpedoes.

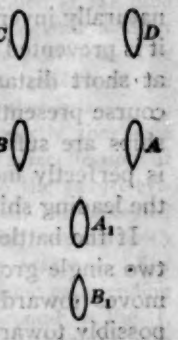


FIG. 41.

It results from the foregoing that the maneuver for the employment of the torpedo in battle at close quarters harmonizes with what is necessary for the possibility of ramming.

Let us now place what we have set forth in its relation to the employment of the guns.

It being admitted that, within a certain limit of distance, the adversaries must steer for each other, it is well to consider this necessity in connection with the other necessity of firing with the maximum number of guns permitted by the development of the action; consequently, while in long-range battle, a ship has to keep the enemy bearing in a sector of maximum offense, inside of the aforesaid limit it would be in a position which permits of firing in the direction of the bow. Not only does the line abreast satisfy this condition, but also any other formation in a straight or curved line which permits the ships to fire ahead.

Summing up, we may note that, considering the three weapons together, the best arrangement for the ships in battle at close quarters is that which permits the simultaneous employment of the forward guns, and differs as little as possible from the column of vessels; in other words, it is a question of a line of bearing that makes a small angle with the direction of the course.

In steering for battle at close quarters the ships of each group must hence take, by prompt formation (any other method is evidently impossible), the aforesaid position with respect to the most advanced ship in the direction of the course; doubtless the distance between ships will not be the same, and, in fact, the formation will differ in practice from a line of bearing; but there is no need to trouble about that. In effect, it is sufficient for the ships to be echeloned on the side that possibly will be indicated by the admiral, or that the situation with respect to the enemy shows to be opportune.

Each ship of the group, after passing by the enemy, must naturally invert the course in order to run again upon him, unless it is prevented from making such a movement by the quick arrival at short distance of the enemy's ships. This inversion of the course presents no dangers of collision with friendly forces if the ships are sufficiently echeloned in depth and the opportune side is perfectly indicated, it being naturally the same toward which the leading ship has turned.

If the battle at close quarters, instead of taking place between two single groups, is general, according to the foregoing a party moves toward it with the single groups following each other, possibly toward the same part of the enemy, so as to obtain the concentration of forces.

DISCUSSION.

Collision between H. M. S. "Hawke" and R. M. S. "Olympic."

(See No. 140.)

Naval Constructor D. W. Taylor, U. S. Navy.—Referring to Lieutenant Nixon's account of the *Hawke-Olympic* collision I must say that I was very sorry to see this published in the Naval Institute Proceedings. Suits arising from the collision were in court and undecided at the time and such a publication could not have been made in England without serious danger that the author and the publisher would be punished. The matter being *sub-judice* I do not think it good policy to publish in the Institute any article ascribing blame or responsibility to either side.

It is well known that no two witnesses will give exactly the same account of even a simple occurrence. Lieutenant Nixon's recollection of the circumstances of the collision is not only opposed to the sworn evidence of a number of officers of the English Navy which was accepted as correct by the court, but is inconsistent in material respects with facts demonstrated in court by the strongest possible evidence. For instance, Lieutenant Nixon, in Fig. 1, represents the *Olympic* as intending to pass north of the Ryde Middle, called the Middle Ground in Fig. 1. Every witness from the *Olympic*, in a position to know, testified that after rounding the West Bramble Buoy she steered a course S. 59° E. intending to pass south of the Ryde Middle. The appended chart shows the place of collision as claimed by the *Hawke* and accepted by the court. It also shows the place of collision according to the *Olympic*, which was rejected by the court. It also shows in full lines the courses of the *Olympic*, S. 59° E., and of the *Hawke*, S. 74° E. prior to the collision as fixed by the court.

The place of collision fixed by Lieutenant Nixon is far removed from even the place claimed by the *Olympic*.

Lieutenant Nixon's statement that on board the *Olympic* "nothing was done either with helm or engines" is contrary to positive testimony from the people on the bridge of the *Olympic* that when the *Hawke* sheered in the *Olympic* helm was put hard a-port before the collision. As to his doubt "that anyone on the *Olympic's* bridge had the slightest warning of the collision until the instant of actual impact" there was positive testimony from the *Olympic's* people on the bridge that they saw the beginning or early stages of the swerve. The captain of the *Olympic*, with reference to the time from the beginning of the swerve to the instant of collision, said "it seemed a long time but under a minute." The captain of the *Hawke* thought the time about 40 seconds. There seems little doubt that Lieutenant Nixon's account, with reference to what the *Olympic's* people did and saw, is materially in error.

While not very clear, Lieutenant Nixon's account appears to be that the *Hawke* was gaining on the *Olympic* until she began to swerve. From the time when the *Hawke* was "coming up fast" and "just beginning to lap" the *Olympic* to the beginning of the swerve he allows two intervals each of "a few seconds" only.

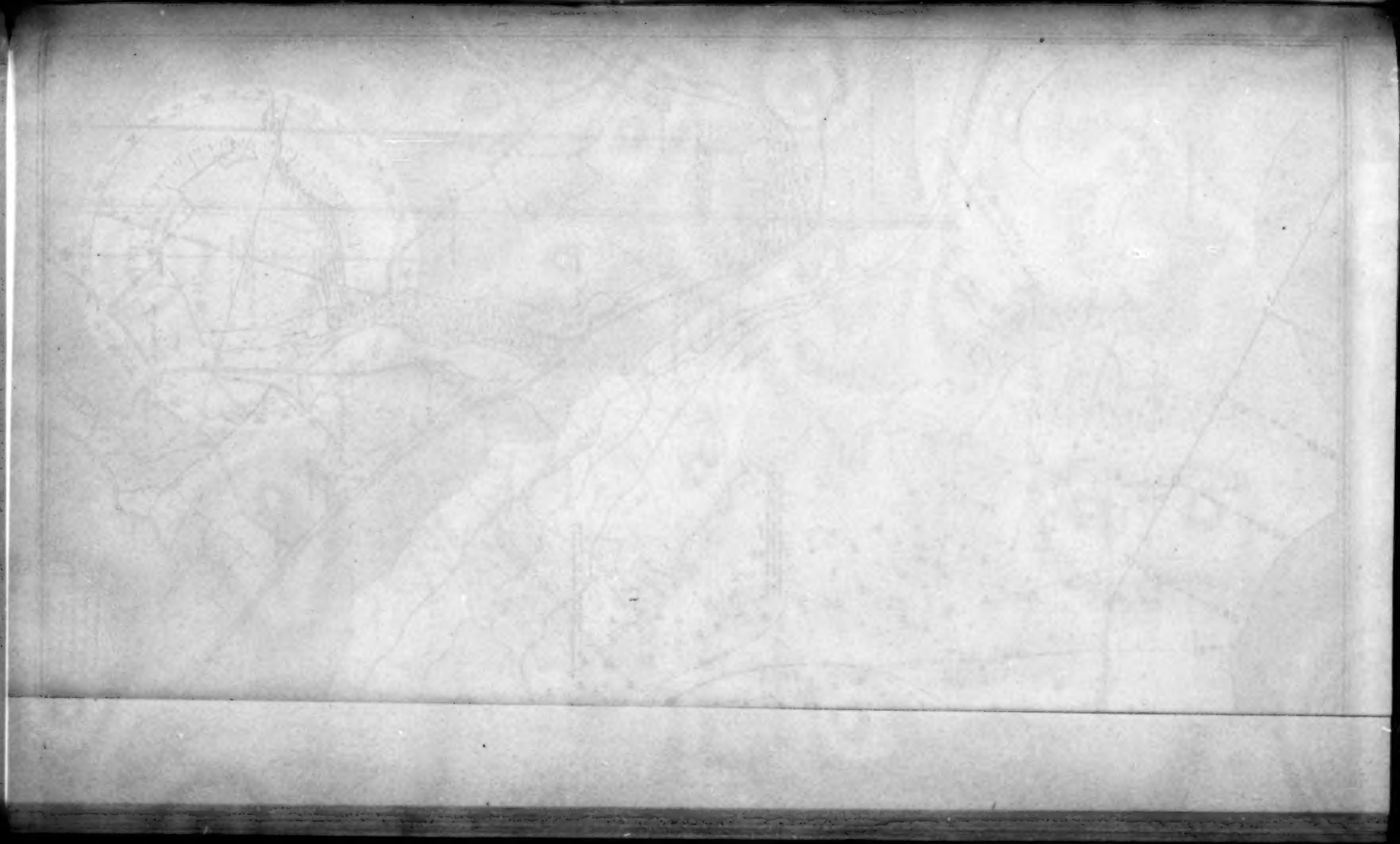
In the suits there was testimony from both sides that at the beginning of the swerve the *Olympic* was going faster than the *Hawke*. The *Olympic's* officers on her bridge—but not all the witnesses on that side—testified that the *Hawke* gained until her stem was about abreast the *Olympic's* bridge and then the *Olympic* drew ahead and had gained about 200 feet when the swerve began with the *Hawke's* stem about abreast the center of the *Olympic*. The *Hawke* witnesses also put their stem as abreast the middle of the *Olympic* at the beginning of the swerve, but claimed to be much further ahead at the time the *Olympic* began to draw ahead. Lieutenant Nixon's account is inconsistent with both of the others. Of course, as I said before, no two witnesses will give exactly the same account of a given occurrence, but if Lieutenant Nixon's recollection is even approximately correct as to many of the most important circumstances there were certainly a number of exceptionally unreliable observers on the *Hawke* and *Olympic*.

I append hereto the decision of the judge, Sir Samuel Evans, in the suits growing out of the collision which gives much information about the testimony, etc., together with a most acute analysis of it and the reasons for the findings of fact. The appended chart will facilitate following the decision. It is not a part of the judgment, being prepared on the government side, but it will be seen that its accuracy is virtually sustained in the decision. Dotted lines connect simultaneous positions of the two ships claimed by the *Hawke* side. The times marked for these simultaneous positions differ by a minute because they are the two times of the two ships whose clocks were a minute apart.

As supplementing the information given in the decision it may be interesting to recite briefly the happenings on the *Hawke* immediately before and after the collision, as told by her witnesses. The commanding officer—Commander Blunt—was in charge and on top of the pilot house which is on the bridge. The steering wheel is in the pilot house at the level of the bridge and the engine telegraphs on the bridge near the center.

As soon as Commander Blunt saw the Old Castle Buoy clear of the red conical buoy off the end of Prince Consort Shoal, he gave the order port 5 degrees. The *Hawke* answered her port helm and had swung through 6 to 10 degrees when she ceased to swing to starboard and began to swerve rapidly to port. When Commander Blunt observed this his first order was "hard aport" which he followed almost immediately by the order "stop port; full astern starboard." As that order was being given the helm was reported jammed. Something jammed after the helm had been put over 15 degrees and three men were unable to move the steering wheel. Immediately after the collision the steering gear was in perfect working order and the cause of the jamming has never been ascertained. On giving the order "stop port; full astern starboard" Commander Blunt

Calshot Spit
Thorn Knoll
BRAMBLE BANK
Place of Collision according to Olympic
COWES ROADS
12·35
12·36
12·40
12·41
12·42
12·43
12·44
12·45
12·46
12·50
S 55° E
S 28° E



sprang to the head of the port ladder leading to the bridge from which he could see the telegraph. When the helm was reported jammed he made one leap to the bottom of the ladder giving the order "full astern both" and himself threw the port telegraph which had been put at "stop" to "full astern." The starboard telegraph was already at "full astern." The engines of the *Hawke* were going astern at the time of the blow. The upper part of the *Hawke's* stem appears to have held strongest to the *Olympic* and as the latter drew clear the pull on the *Hawke* heeled her over about 15 degrees to starboard. Her head, of course, swung to starboard also and she was turned completely around and backed across the *Olympic's* wake before the engines were stopped. The compass card was spinning so that it was impossible to take bearings at first. Several minutes after the collision bearings were taken and the *Hawke* located at the point marked 12.50 on the chart.

I may say in conclusion that while fully agreeing with Lieutenant Nixon that the swerve of the *Hawke* was initiated by suction, so called, I am strongly of the opinion that had the *Hawke* approached the *Olympic* in the manner described by him the effect of suction upon her would have produced results very different from those that actually took place. This, however, being somewhat a matter of opinion, I have restricted my discussion to matter concerning which the evidence on the trial for both sides seemed to render it practically certain that Lieutenant Nixon's recollections were erroneous.

A study of the decision will show that as regards some further matters I have not touched on, the findings of the judge as to the facts, arrived at after weighing and analyzing contradictory evidence, differ a good deal from Lieutenant Nixon's recollections.

TRANSCRIPT OF THE OFFICIAL SHORTHAND WRITER'S NOTE OF THE JUDGMENT.

THE PRESIDENT.—These two actions relate to a collision which took place between the SS. *Olympic* and H.M.S. *Hawke*, on the 20th September, 1911, off Cowes, Isle of Wight.

The first was brought by the SS. *Olympic* against Commander F. Blunt, of H.M.S. *Hawke*. The second was brought by the Commissioners for Executing the Office of Lord High Admiral of the United Kingdom against the owners of the SS. *Olympic*.

The first action was brought against the commander because no action lies against the Admiralty Commissioners, but in substance the plaintiffs in the one were in the position of the defendants in the other, and vice versa.

The two actions were tried together, and involved identically the same questions with reference to the cause of the collision. They were tried together by consent. The case for the *Olympic* was opened first.

The collision took place on a fine day, not long after midday, in an open channel. The situation was free, and was not complicated by the presence, or navigation of any other vessels. One of the colliding vessels was the largest and finest product of the shipbuilding enterprise and skill

of the first maritime nation of the world; the other was one of the protected cruisers of her navy. The contemplation of the calamity, and of the damage which resulted from it, cannot but produce a feeling of regret, and even a sense of pain.

It ought not to have happened, but it did happen, and I have, to the best of my ability, to decide upon the evidence how and why it happened, and who are, or is, to be blamed for it, according to the law of Admiralty.

The *Olympic* is a triple screw steamship, of 45,000 tons gross, and 24,000 tons net register, of 882½ feet in length, of 92½ feet beam, fitted with turbine and reciprocating engines, with a combined power equal to 59,000 horse-power indicated, and manned by a crew of 885 hands all told. Her draft at the material time was 33 feet 6 inches forward and 34 feet aft. Her displacement at a mean draft of 33 feet 6 inches in sea water is 50,500 tons, and at 34 feet 51,340 tons. She is a veritable "Leviathan that maketh the deep to boil like a pot."

H.M.S. *Hawke* is a twin-screw first-class protected cruiser of 360 feet length, of 60 feet beam, with an indicated horse-power of 10,000 indicated with natural draft and 12,000 with forced draft. At the material time she was drawing 22 feet 4 inches of water forward, and 24 feet 6 inches aft. Her displacement was approximately 7600 tons.

The bridge of the *Olympic* was 190 feet abaft her stem, that of the *Hawke* was 91 feet abaft hers; so that in proportion to the lengths of the vessels the position of the bridge on each was approximately the same.

The *Olympic* was proceeding from Southampton water towards Spithead through the channel south of the Ryde Middle Bank on her fourth voyage across the Atlantic. The *Hawke* was proceeding from the Solent towards the Nab Lightship through the same channel in the course of making her annual power trials. In these trials a certain power of the engines is developed for a certain period, for the purpose of not only testing the engines, but of testing the engine-room complement and their capacity and power for keeping steam. The trials had no concern with speeds; but speeds were taken for navigation purposes.

The vessels sighted each other between 3 and 4 miles distant. At that time the *Olympic* was coming down in the Thorn Channel—which is a deep-dredged channel—near the North Thorn Buoy, and the *Hawke* was going up the Solent, in the vicinity of the Gurnard Ledge Buoy. Each had the other more or less on her port bow at that time.

They both proceeded on their ways, and about 4 minutes later, the *Olympic* blew two short blasts expressly for the *Hawke*, in order to let the *Hawke* know that she was on the starboard helm, and bound for the eastern passage through the channel towards Spithead. This signal was blown when the *Olympic* was about two-thirds of the way between the Thorn Knoll Buoy and the West Bramble Buoy; and thereupon the *Olympic* began to take her turn around West Bramble Buoy to get into the channel. The distance between the vessels was from a mile to a mile and a half when the signal was sounded.

The cruiser at this time was getting near Egypt Point (Isle of Wight), and had the *Olympic* broader on her port bow. In turning the *Olympic's*

starboard bow was exhibited to the port bow of the *Hawke*. As the *Olympic* was turning on starboard helm to round the West Bramble Buoy to get into the channel, the *Hawke* was turning on port helm to round Egypt Point, to get into the same channel.

It was said for each vessel that after her turn was completed, she straightened on a definite course, which was kept practically until the throes of the collision. What these courses were will be discussed and decided later. The distance from the place where the commander of the *Olympic* said she was steadied on her course, and the spot where he marked the collision was a little under 9 cables, viz.: 1770 yards.

The distance from the place where the commander of the *Hawke* said the cruiser was steadied on her course to the spot where he marked the collision was 11 cables, or 2200 yards.

Although the respective positions, courses, and speeds of the two vessels at earlier stages have to be looked at for some purposes, it is mainly, if not entirely, upon their respective positions, courses and speeds, at and from the time when they straightened on the final courses that the decision of these actions depends.

It will be convenient now to state what the case was which was put forward on behalf of each vessel. It can be done quite briefly.

The case for the *Olympic* was that the *Hawke* was at all material times the overtaking vessel; and that, as such, the duty lay upon her to keep out of the way of the *Olympic* as the overtaken vessel, under the Article of the King's Regulations, which corresponds with Article 24 of the Regulations for Preventing Collisions at Sea, and that she committed a breach of that duty.

The case for the *Hawke* was that at all material times the two vessels were crossing vessels within the meaning of Article 19 of the last named regulations, and the corresponding Article of the King's Regulations, and that as the *Olympic* had the *Hawke* on her own starboard side, the duty lay upon her to keep out of the way of the *Hawke* and that she (the *Olympic*) committed a breach of that duty.

Whichever vessel had to keep out of the way of the other, there was a corresponding duty upon that other under the regulations to keep her course and speed.

These were the main contentions, and to these the mass of the evidence and the arguments were directed. There are other matters which arise, and must be dealt with, viz.: the allegation that at the last moment action ought to have been taken by one ship or the other to avert the collision, even though the initial blame was on the other; and also the defence of compulsory pilotage, and the counter allegation that if the fault lay with the *Olympic*, her compulsory pilot was not solely to blame.

I now propose to deal with the main issue. Was the *Hawke* the overtaking vessel, and the *Olympic* the overtaken vessel? Or were they crossing vessels?

In order to determine this issue, it is necessary to look at the whole of the evidence, and especially to come to a conclusion as to the spot of the collision, the courses of the vessels, their speeds, their bearings, their distances, and their helm actions at the material times.

An overtaking vessel is defined as one "Coming up with another vessel from any direction more than 2 points abaft her beam, *i. e.*, in such a position, with reference to the vessel which she is overtaking, that at night she would be unable to see either of that vessel's side lights." Crossing vessels are vessels travelling upon converging courses so as to involve risk of collision.

The *Olympic* set out to prove a story which may briefly, but with substantial accuracy be stated as follows: That after passing the North Thorn Buoy (where her speed was 17½ knots) she reduced her speed, and that from that point up to just before the collision, the *Hawke* was travelling at a greater speed; that after turning the West Bramble Buoy she straightened on a course of S. 59° E.; that when she steadied on this course, the *Hawke* was at least a quarter of a mile astern, bearing about 2½ or 3 points on her starboard quarter: that the *Hawke* was on a parallel course with her for about a mile before the collision, and distant laterally about 300 yards; that from the position astern, the *Hawke* came up to and overtook her, and that when the stem of the *Hawke* was opposite her bridge, she had attained the greater speed and shot ahead, and the *Hawke* fell astern; and finally that the *Hawke* starboarded right into her starboard quarter, and struck her almost a right angle, about 80 or 90 feet from her stern.

On the other hand the story of the *Hawke*, stated in a similar way briefly, but with substantial accuracy, was as follows: That she came up the Solent on a course N. 77° E., and turned round Egypt Point at a distance of about 3½ cables from the land, that by reason of the presence and course of the *Olympic* she steered a course of S. 74° E., intending to pass the three buoys outside Cowes, viz., the West Conical, the Chequer, and the East Conical (also called the Prince Consort) Buoy at a distance of between 20 and 30 yards on the north side; that her speed was less than that of the *Olympic*, and that she was never overtaking; that the vessels were on converging courses of 15 degrees; that the *Olympic* came within about 100 yards of her, and that in comparatively shallow water by certain forces called suction, or interaction, she was at last, when brought into this close proximity, drawn into the *Olympic* so that she collided at an angle of something between 4 and 5 points.

The case depends upon fact, rather than upon law. It is not only an important case, it is also in many respects complicated. But, after full and careful consideration, I have arrived at definite and clear conclusions.

In order to test the evidence, especially the evidence which consists of impressions, opinions, and observations (of greater or less accuracy) it is desirable and indeed essential, to determine certain matters which ought to be capable of fairly correct ascertainment.

In the first place, if the spot of the collision can be fixed, we have one of the chief determining factors of distances, of courses, and of bearings.

In the next place, if the speeds of the vessels can be ascertained, or even approximately ascertained, a useful test is provided for bearings, courses, and distances.

The place of collision was in dispute. It was regarded and properly regarded, by both parties as a very important matter. It was only vaguely

stated in the Preliminary Acts and Pleadings. In the interlocutory stage of the proceedings, about a fortnight before the trial, I made an order that each party should mark upon a chart, as particulars in the actions, the place of collision as alleged, and I ordered that the charts so marked should be exchanged at the same time, so that neither party should know beforehand where the place would be fixed by the opponent. The places were marked, and the marked charts were exchanged accordingly.

The spot fixed by the *Olympic* was about 220 yards to the N.N.E. of that fixed by the *Hawke*. These two spots I call "The *Olympic's* place of collision"—and "The *Hawke's* place of collision," respectively, and, according to the ordinary rules of practice in legal proceedings, each party ought to be bound, as by particulars, to the places so marked.

At the trial three of the chief witnesses for the *Olympic* were required to, and did state and mark the place where they said the collision occurred. They were Captain Smith, the pilot, and Colonel Sexton White. Neither of them agreed with "The *Olympic's* place of collision." Nor did any of them agree with either of the others as to the spot. Captain Smith marked a spot about 260 yards to the N.W. of the *Olympic's* place of collision, and the pilot a spot about 420 yards to the N.W., and Colonel White a spot about 650 yards to the S.E.

The *Hawke's* place of collision was deposed to by Lieutenant Aylen, the navigating officer of the *Hawke*, and by Commander Blunt.

It was fixed by reference to a position taken a few minutes after the collision, when the *Hawke* came to rest, by Lieutenant Aylen by the direction of Commander Blunt. This position was taken by means of two sets of bearings, and was logged by Lieutenant Aylen at the time. By a mistake it was logged as the place where the "ship was struck." Lieutenant Aylen said he made the entry "ship struck" in the hurry and excitement of the moment; but that that position was really that in which the ship came to rest. I believe this statement. I also believe that the spot to the southward and westward which was marked as the *Hawke's* place of collision was, as nearly as can be ascertained, the actual spot of the collision.

The *Olympic's* witnesses did not fix their places of collision with reference to any accurate bearings.

Their positions were only given as the result of general impression, and as stated they all varied, and varied considerably.

I accordingly decide for the purposes of this case that the *Hawke's* place of collision is where it must be taken to have actually occurred. I now state by comparison, and for reference, the distance from the various spots of collision spoken to by the three before-named witnesses for the *Olympic*, to what I have decided was the actual place of collision. Captain Smith gives his, 400 yards away in a direction about N. by W. The pilot gives his, 540 yards away about N.N.W., Colonel White gives his, 650 yards away about E.S.E.

The place of collision will be very important, as I afterwards point out, in deciding as to the course of the two vessels and the lines of those courses in the channel.

Now as to speeds. The maximum speed of the *Olympic* in the open sea is about 22½ or 23 knots an hour. The maximum "reduced speed"—*i. e.*, in channels like the Solent—is about 20 knots. Half reduced speed is about 15 knots. In getting up to North Thorn Buoy the *Olympic* was going through the water 17 or 17½ knots. She slowed to make the turn round the West Bramble Buoy, until her speed at the end of the turn and when she steadied on her course was said to be 11 or 12 knots; whether it was as low as this is doubtful. All engines were then put full speed ahead, and it was pleaded and stated in evidence, at the time of the collision, her speed through the water was 16 knots Her captain said that from about 12 knots it would take her three or four minutes to attain her maximum reduced speed of 20 knots. Professor Biles, by his calculations, supported that statement. This evidence is, in my opinion, more reliable than that from the engine room upon this matter. According to her recorded times she straightened on her course at 12.43 p. m., and the collision happened at 12.46 p. m. This means a minimum of 3 minutes; and a maximum of 4 minutes, because the times taken were from electric clocks which (with the exception of the master clock) jumped a minute at a time, and did not record anything between the minutes. In this interval I think she must have reached a speed nearer 20 knots than 16 knots.

This question of her speed between the time she straightened on her course and her colliding, can be tested or checked in various ways. The distance from the North Thorn Buoy to the *Olympic's* place of collision as she went, is 2½ knots. According to the log the time in which this distance was covered is 9 minutes; this gives an average speed of 16.6 knots an hour—and it includes the lower speed in rounding the buoys. If a mean time of 9½ minutes is taken, the average speed would be 15.8 knots; and if a full ten minutes is taken the average would be 15 knots. The distance to the actual place of collision is greater, and the average speeds would accordingly be somewhat higher in each case. From the Thorn Knoll Buoy to the *Olympic's* place of collision the distance is about 19½ cables. The time given in the *Olympic's* log for travelling this distance is 6 minutes—that gives an average speed of 19 knots an hour. At the mean of 6½ minutes, the average speed would be 17.3 knots an hour, and at the full 7 minutes, the average would be 16.7 knots an hour. Again, the distance to the actual place of collision is greater, and the average speeds in the three instances would be higher accordingly.

Similar calculations for one more distance will suffice, viz., that between the position in which the *Olympic* straightened on her course after the turn, as fixed by her captain and the actual place of collision. This measures 1 knot. The time recorded in her log for this distance is 3 minutes. This gives an average speed of 20 knots an hour. If the mean is taken as before as between 3 and 4 minutes, the average speed is over 17 knots an hour, and taking the full 4 minutes there is an average speed of 15 knots.

The conclusion to which I have come is that the speed of the *Olympic* at the time of the collision, and for a few minutes preceding it, was greater than that stated by her witnesses.

The speed of the *Hawke* can be fixed with more certainty. The cruiser was, as stated, on power trials. Commander Blunt and others gave evidence that her speed was 15¼ knots at and for some time before the accident.

Between 7.30 and 11.30 a. m. she had been engaged in making trials of her full natural draft power (which is equal to four-fifths of the forced draft power) and from 11.30 up to the accident in making trials of her three-fifths natural draft power. For the former trials the number of revolutions made were 92 per minute. If the bottom of the cruiser had been clean, the speed on that number of revolutions would have been 18.4 knots: five revolutions per minute being equal to a knot per hour. But she had not been in dock for a year, and her bottom was in a state which impeded her designed speed, and the results obtained were an average of only 17 knots an hour. For the three-fifths trials from 11.30 o'clock the number of revolutions was eased down to and kept at 82. This was proved by the engine-room log and by several witnesses. If the bottom of the ship had been clean this would have given a speed of 16.4 knots, but in the state in which she was, she would fall short of this, and in proportion as before her speed would be only a little over 15 knots.

This, I find upon the evidence, was about the speed of the *Hawke* for some time before, and at the time of, the collision.

I now come to the consideration of the important matters of the courses and bearings of the two vessels.

First, with regard to the courses of the *Olympic*. They are not in any uncertainty. When she first sighted the cruiser she was on a course of S. 65° W. magnetic, and this course was continued till she starboarded for rounding the West Bramble Buoy. When she gave the two-blast signal for this helm action, she had the cruiser on her starboard bow. After she finished the turn she steadied on her new course, which was S. 59° E. This course had previously been entered in her log as follows: West Bramble to Peel Buoy, S. 59° E."

She remained on it until immediately before the blow, when her helm was put hard-aport, which altered her heading about a point.

There is no doubt about this course of S. 59° E. The position of the vessel in the channel depended, of course, upon the place where she was when the course was set. About this there was considerable dispute. The *Olympic's* witnesses placed her much more to the north of the channel than those for the *Hawke* did. This question and the other connected with it, namely, the position of the *Hawke* in the same channel when she got on her last course before the accident, is all important and required careful investigation. This will be done a little later.

Next as to the course of the *Hawke*.

When she first sighted the *Olympic* her course was N. 77½° E. magnetic. The commander said that by reason of the presence of the *Olympic* he turned Egypt Point, and put his vessel on a course of S. 74° E. Counsel for the *Olympic* contended that this course was never set, and the *Hawke* was never upon it. Commander Blunt said he took this S. 74° E. course from the line of three buoys off Cowes which he could see in front of

him, viz., the West Conical, the Chequers, and the East Conical, and steered more especially by the Chequers, which was the outlying one, to pass clear, but as close to them as he could; and that following that course he passed about 20 yards off the Chequers, and about 30 yards off the others. There was another cruiser called the *Edgar* lying ahead anchored in Stokes Bay; and the man at the wheel was told to steady on the *Edgar*. Where a fixed object lies in or quite near a course, the helmsman is often in practice told to steady on such an object, not so much to steer for it as to have ready assistance to keep the ship's head steady.

The position where the *Edgar* was anchored was proved; and the bearing of the *Edgar* from the *Hawke* when the latter was off the Chequers Buoy was S. 73° E., which confirms the course said to have been set. Commander Blunt said he was absolutely certain about the course. His evidence was also that the *Olympic* was still on her turn when he steadied on the S. 74° E. Lieutenant Aylen testified to seeing that the course was S. 74° E. on the standard compass after the commander steadied her, and to hearing afterwards the order to the helmsman to steady on the *Edgar*, or steer for the *Edgar*. Lieutenant Bashford heard the order to steady on the *Edgar*—and saw that the vessel was in fact so steadied. Hunt, a quartermaster on the bridge, said he saw the *Hawke* steadied on S. 75° E.—this was by his steering compass—and heard the order, "Steady on the *Edgar*," and that he himself took the wheel by Lieutenant Bashford's direction and steadied the ship on the *Edgar*. So much for the evidence from the *Hawke* upon the question of this course.

How does the evidence from the *Olympic* fit in with this? The pilot in charge said that when the cruiser was about a quarter of a mile away on his starboard quarter, he saw that she had altered from her original course, *i. e.*, (N. 77° E.) and had got on No. 2 course. To quote his own words, "She was on No. 2 course then. I will call it E. by S." That is S. 78¾° E.—converging more upon S. 59° E., by 4¾° that S. 74° E. would be. Later he said that at that time she was heading towards him converging 1¼ points, which would be S. 75° E., and ultimately he stated in terms that the cruiser might have been heading upon a course of S. 74° E. His case upon this was that she afterwards ported and came on a parallel course with the *Olympic*. Upon the evidence for the *Hawke* and upon the testimony from the *Olympic's* pilot, I find that after turning Egypt Point, the *Hawke* was steadied on a course of S. 74° E.

We have now arrived at this: that after the two vessels were steadied upon the completion of the turnings, their courses were S. 59° E. and S. 74° E. respectively. They were, therefore, converging at an angle of 15 degrees, and if their courses were pursued, risk of collision was involved.

I stated before that the positions in the channel of the two lines of these courses were important and required careful investigation. They determine not only the respective parts of the channel to which each vessel got; but also in large measure the disputed point as to whether the *Hawke* subsequently ported herself into a parallel course.

The cases of the two vessels are contradictory. The *Olympic* alleged that the *Hawke* came much further north into the channel than a turn

round Egypt Point required or fitted. Captain Smith brought the *Hawke* up to a position (which he marked on a chart) about 6 cables and 130 yards north of Egypt Point; and the pilot brought her up about 8 cables and 160 yards to N.N.E. of the point. The allegation of the *Hawke* was that she rounded Egypt Point about 3½ cables off.

The *Olympic's* evidence was directed to prove that she was in a good mid-channel course when she steadied on S. 59° E., because she so steadied with No Man's Fort open on her starboard bow, 1, 2, or 3 degrees. The course recorded in the log was, as I have said, "West Bramble Point to Peel Buoy, S. 59° E." No Man's Fort was distant about 8½ miles; Peel Buoy was 3½ miles. Her course would have to be changed at the Peel Buoy, and at various other points long before reaching No Man's Fort. It could not be reached on that course. The vessel would have been on the banks before long.

It might have been that the helmsman was told to keep an eye on that well-known distant fixed object so as to help him to keep the head of his huge craft steady, but Helmsman Haine's story about this was very extraordinary. He did not mention No Man's Fort in his examination in chief, when he said what course he steered. In cross-examination he said: "When I got the order to steady, there was just the No Man's Fort on the starboard bow, 2 points." He insisted over and over again that the fort was "2 points" or "22 degrees" on the starboard bow. That, of course, was impossible, but such was the state of his mind upon it when his evidence was given.

I cannot accept the story that the course was fixed and kept upon a line showing No Man's Fort a little (up to 3 degrees) on the starboard bow. A few degrees at such a distance would make all the difference. A line with the fort 2 degrees on the starboard bow would bring the vessel quite close up to the Ryde Middle Shoal, and 3 degrees or more right on the shoal. Therefore, the exact line of the *Olympic's* course in the channel cannot properly be determined by considering angles between her and the fort.

The evidence from the cruiser was led to establish that she passed within 3½ cables of Egypt Point, and that her S. 74° E. course from there kept her on the extreme starboard side of the channel, and brought her as close as she could get to the three buoys already referred to.

All the officers who were called from the *Hawke* testified to this. Lieutenant Aylen observed the position at three places, at Solent Bank Buoy, Gurnard Ledge Buoy, and Egypt Point. He entered these, with the times, in a note book, which unfortunately, was lost overboard at the shock of the blow between the vessels when he stood in the chains on the side which struck. Lieutenant Aylen's honesty and integrity were not impeached. His evidence must, in the absence of the lost book, be considered as that of any other witness. If he is right in his recollection, he established the line on the N. 77° E. course as being about a cable inside the line of S. 77° W., which was, and is marked on what was called the impounded chart, and which I marked "F," and proves that Egypt Point was passed about 3½ cables off. If the course was set, as I have found

it was after the turn, and if it was set at about this distance off the point fixed by Lieutenant Aylen and others, and if it was followed up to and close along the line of the three buoys, then one is not surprised to hear, and one is naturally prepared to accept the evidence that Commander Blunt remarked to the navigator that the *Olympic* was coming unpleasantly close, and asking him when just past the Chequers Buoy, whether he could haul any more to the starboard, and that the reply given was: "Not till you are past the Red Buoy," meaning the East Conical Buoy, and that as soon as he could see the Old Castle Point Buoy clear of the Red Buoy, he gave the order to port which he said he gave.

Again, what is the evidence from the *Olympic* upon this? As to the position of the *Hawke* in coming up the Solent the pilot gave evidence. He said that when he blew the two-blast starboard helm signal to let the *Hawke* know that he was rounding the West Bramble, she was 1½ miles away from him right in mid-channel, abreast of Gurnard Bay, coming up on a mid-channel course of N. 77° E., and as near to East Lepe Buoy as she was to Gurnard Ledge Buoy. Now the distance between these two buoys is 6 cables. But if a line is drawn on a course of N. 77° E. from the spot where the pilot marked the *Hawke* when the *Olympic* steadied on her last course (even supposing that the *Hawke* had not before changed to a southward and eastward course) past the East Lepe Buoy, it would pass Egypt Point rather over 6½ cables away, but it would go within 30 or 40 yards of East Lepe Buoy and over 5½ cables away from the Gurnard Ledge Buoy. It would also go over the Solent Bank. The same can be said within 70 or 80 yards of a similar line drawn from the corresponding spot marked by Captain Smith. The evidence of the pilot on this point is nearer the truth than his marking on the chart, and is more consistent with that of Lieutenant Aylen as to the distance from the land of the *Hawke's* up-channel Solent course. Reference may also be made to the evidence of Mr. Lashmer, the master of the yacht *Belinda*. He described where his yacht was off Cowes, and said he saw the *Hawke* turn Egypt Point; he said he could see without any difficulty at what distance from the land the *Hawke* made the turn, and he gave the distance as 300 yards only.

For these reasons, amongst others, I find that the line of the S. 59° E. course of the *Olympic* was much further south than her witnesses stated; and that the line of the S. 74° E. course of the *Hawke* was substantially where it was stated to be by Commander Blunt and Lieutenant Aylen.

This conclusion is consistent with what I have found to be the true place of the collision. The explanation of the *Olympic* coming so far south is, I think, that the pilot with his huge vessel made too large a sweeping turn round the Brambles. What tide there was—half a knot—would also tend to set her to the south.

Now I must deal with the question of whether the *Hawke* was at any time the overtaking ship, and whether she is to be regarded as the overtaking ship at the time of the collision. Was she at any time coming up with the *Olympic* from a direction more than 2 points abaft her beam? In the course of his final address I asked Mr. Laing at what time the vessels

ceased to be crossing vessels, if they ever were crossing vessels; and at what time they became overtaking and overtaken vessels. His reply was that that raised a point which had to be considered with great care, that he was not sure of the exact answer he was going to give at the moment, as he had not considered it. But I assume from the way the evidence was placed before the court, that the *Olympic's* contention is that at any rate from the time when she was steadied on her S. 59° E. course the *Hawke* was the overtaking vessel and ought to have kept out of her way. Many witnesses deposed that at this time the *Hawke* was 2½ to 3 points on her starboard quarter and distant a quarter of a mile or more. They placed the *Hawke* therefore 5 to 5½ points abaft the beam of the *Olympic*, and said she was much the faster vessel until the *Olympic* came to pass the *Hawke* just before the accident. There was an extraordinary similarity, amounting almost to complete identity, about their evidence. Much reliance was placed upon it by counsel for the *Olympic;* and especially upon the testimony of Colonel Sexton White. This gentleman was a man who had experience of steam trials and who was pretty familiar with ships. He placed the *Hawke* at about a quarter of a mile (400 to 500 yards) away from the *Olympic* and on her starboard quarter. He had no practical knowledge of "points" of the sailor's compass; but when asked to show by models the relative positions of the two vessels, he placed the *Hawke* about 5½ points abaft the beam, on the starboard quarter of the *Olympic*. This body of evidence, if it could be relied upon as being the result of accurate and nautically intelligent observation, would be very important. But general observation as to the distances, bearings, and speeds of two vessels turning at different points, at a considerable distance away, about the same time, and then angling towards each other is difficult and liable to great errors. Evidence of that kind requires to be submitted to a careful test; and tests are available in this case. None of the observers at the time were thinking of any collision, and none of them made observations with reference to any fixed objects on the land or otherwise. They may have made mistakes, and harbored inaccurate impressions. Even Colonel White, who was perhaps the most trained and intelligent of the witnesses, was clearly mistaken as to the place of collision, and of the place where he described the *Hawke* to be when he said she starboarded into the *Olympic* just before striking her. Of such places he would be likely to take note, and indeed he noted them in this instance by reference to a fixed object on the land close by. He said that when the *Hawke* starboarded, she was rather to the eastward of Old Castle Point, and that the *Olympic* had got abeam of old Castle Point at that time. But the place of collision was in a direction not eastward but N.N.W. from this point, and on her course the *Olympic* would not have been abeam of the Point for another 750 yards beyond where she collided; or, to test the value of such observations in another way, she would not have been abeam of the Point for another half a mile beyond where Captain Smith said she collided. Other observations by the same body of witnesses produced upon them the impression apparently that the vessels were for a long time upon parallel courses, brought to the parallel, according to the pilot, by the *Hawke* porting from her S. 74° E. course.

The evidence, as has already been pointed out, established that the vessels were never brought on parallel courses at all. There are still safer tests of the accuracy of such observations, or impressions, which show that they are not reliable. It is capable of mathematical demonstration that if the ships were on converging courses of 15 degrees (which it has been shown they were) and the *Hawke* was a quarter of a mile away, and 5½ points abaft the beam of the *Olympic* (as most of the witnesses say), the *Hawke* would have to travel just about twice as fast as the *Olympic* in order to meet her at the point of intersection. I have found the speed of the *Hawke* to be 15 or 15¼ knots an hour, on evidence which appears to me to be unanswerable; accordingly the *Olympic* would only travel from where she was straightened on her course to the point of intersection at 7½ knots, or so, which is absurd.

Similarly, with the *Hawke* at 5 points abaft the beam, the ratio of speed to the *Olympic* would be as 11 to 6; that would give a speed to the *Olympic* to the point of intersection of about 8½ knots, which again is absurd.

Apply one other test. The distance between where Captain Smith marked the *Hawke* on the chart, 5½ points abaft the beam when his vessel steadied on her course to the place of collision is 1 mile and 3 cables. (The distance is the same to the place which the particulars chart delivered by the *Olympic* fixed for the collision.) According to the logged time of the *Olympic* the *Hawke* travelled this distance in 3 minutes; to do that would require a speed of 26 knots an hour upon the *Hawke*.

If a mean time of 3½ minutes is taken, her speed would have to be over 22¼ knots an hour.

And even if 4 minutes (which is outside the maximum) are given, her speed would have to be 19½ knots.

These speeds on the *Hawke* are impossible. These tests show conclusively, in my opinion, that the evidence of the impressions as to distance and bearing given by the witnesses referred to cannot be relied upon. The evidence given by Mr. Lashmar, Mr. Gaudion, and Captain Lee was of much the same character, and is open to the same criticism. Further, with regard to the two last-named witnesses, whose range of vision was limited as marked on the chart, it is to be observed that their eidence is quite consistent with what I have found to be the facts, that they should first see the *Olympic* come into sight, and then the *Hawke;* that the opening between the two should be closing to their vision, and that the *Hawke*, being so much nearer, should appear to them to be travelling at a faster rate. The comments upon their evidence which Mr. Aspinall made in his address, and which he illustrated by a diagram, are fair and sound.

It is upon such evidence of general observation as I have been dealing with that the *Olympic* founded her case that the *Hawke* was an overtaking vessel.

Commander Blunt denied that the *Hawke* ever was 2 points abaft the beam of the *Olympic*.

I have come to the conclusion that he is right.

The *Hawke* was *not* an overtaking vessel within the meaning of the rule. If either vessel was, it was the *Olympic*, which overtook the *Hawke*.

I think that in approaching the place where the vessels collided, they were crossing vessels, and, as the *Olympic* had the *Hawke* on her starboard side, she ought to have got out of the way.

From what has already been said about the lines of the courses in the channel, it follows that I cannot accept the version of the *Olympic* that the vessels were laterally apart a distance of 300 yards when the *Hawke* was said to turn on a starboard helm towards and into the *Olympic*.

According to the turning circles of the *Hawke*, if the vessels had been 300 yards away from each other laterally, she could have passed under the stern of the *Olympic*.

They were more like 100 yards apart when the *Hawke* swerved in.

I am asked to decide that the cruiser starboarded in order to get under the stern of the other vessel.

The case for the *Olympic* was that the *Hawke* executed a manœuver under a starboard helm in order to do this.

Even if the distance between them was about 300 yards, as alleged, the attempt would, to use the phrase of Captain Smith, be "an inconceivable manœuver." The commander, three officers, and two men at the wheel on the *Hawke* all denied positively that an order was given to starboard, or that the helm was starboarded. If the intervening lateral distance was something like 100 or 150 yards, the suggested manœuver would be still more inconceivable. To find that it was executed I should have to disbelieve these witnesses. About such a matter there could not be a mistake. The only alternative is that they swore falsely, and conspired to swear falsely. I cannot adopt that alternative. It is to be remembered in this regard, and indeed in regard to the whole of their evidence, that the officers of the cruiser gave their testimony at an inquiry, which was held the day after the accident. At that time it is quite improbable, if not impossible, that they could have any knowledge of the case which would be made on behalf of the *Olympic*, as to speeds, bearings, and so forth. It is not unfair in the circumstances to assume that the accounts they gave at this trial were the same as, or consistent with, those to which they testified at the inquiry. They must have known that their superior officers would carefully watch the evidence that they would give.

I now come to the circumstances which occurred immediately before the vessels came into collision.

When the *Hawke* was in a position to clear the East Conical Buoy an order was given to port her helm 5 degrees. This was done in order to give as much room as possible to the *Olympic*. The *Hawke* changed her heading to the south under this helm to the extent of less than a point. Suddenly, however, she swerved in towards the large vessel. Evidence was given by Mr. Taylor, a naval constructor in the U. S. Navy Department, on the theory of "Suction" or interaction between vessels, especially in shallow water—a subject to which he had given much study. Interesting experiments were also made in the presence of the Elder Brethren and myself. They were not very conclusive, especially as to the direction and extent of the forces, but they showed that disturbing forces were set up. In this case the speeds of the two vessels were high, and the

disparity between the displacements of the two vessels was enormous; they were roughly as 7 to 1; and they were in close proximity. Moreover, if the place of collision which I have accepted is substantially the correct one, it happened that just before the swerve the *Hawke* was passing over the shallowest part of a shoal, which would tend to give her a sheer towards deep water. The *Olympic* was at about the same time passing over a bottom which was irregular and of comparatively small depth.

I have decided that there was no starboarding by the *Hawke* as contended by the *Olympic*—and I am of opinion that in the exceptional conditions which prevailed, the forces set up in the water are sufficient to account for the *Hawke* being carried towards the *Olympic* in a swerve which was beyond her control.

The *Olympic* had ample room and water in the channel to the northward. She came much too close to the cruiser on the south side of the channel. She did not take the proper steps to keep out of the way. She might have averted the collision right up to the last if she had put her helm hard astarboard. Even when the pilot saw the *Hawke* come towards his vessel, he delayed action; and even when he took it, he ordered the helm hard aport, which was a very doubtful manœuver. In the agony of the situation, certain orders were given on the *Hawke*. They did not avail; but they were not wrong. In carrying them out the helm was jammed, but this was an accident for which no one is responsible, and which did not affect the collision.

I cannot find that the *Hawke* is to blame for not acting otherwise or earlier, because she had to keep her course and speed until it was clear that the collision could not be averted by the action of the *Olympic* alone, and, as I have said, action on the part of the *Olympic* at almost the last moment might have prevented the accident.

Complaint was made that the *Hawke* failed to give sound signals when rounding Egypt Point on a port helm, and at the last, when the commander ordered "port 5 degrees" in an attempt to get as far away from the *Olympic* as possible. These signals ought to have been given; but the omission to give them has nothing to do with the collision, and there is no presumption of fault in the case of the king's ship.

On the main issues raised, I therefore find upon the evidence; (1) That the *Olympic* has failed to establish her contention that the *Hawke* was an overtaking vessel bound to keep out of the way; (2) That the vessels were crossing vessels, and that the *Olympic* having the *Hawke* on her starboard side, should have kept out of the way of the *Hawke;* (3) That the *Hawke* was not to blame for what she did, or omitted to do; and (4) That the cause of the collision was the faulty navigation of the *Olympic* by her pilot in going dangerously near the *Hawke* and the non-observance of the rule which required her to keep out of the way.

I am not troubled in this case with the question of whether a breach by the *Olympic* of Article 19 of the Sea Regulations involved a statutory presumption of fault under section 419 (4) of the Merchant Shipping Act, 1894, because I am of opinion that the breach contributed to the accident. This question may have been decided inferentially in the "Sans

Pareil" (1900, p. 267), but upon that, having regard to the decision in the *Hero* (1911, p. —), under another rule, I do not express any view.

One other matter still remains for decision, viz., whether the owners of the *Olympic* are protected from the results of her faulty navigation by the defence of compulsory pilotage.

It was formally proved by the first witness at the trial that the *Olympic* was in charge of a duly licensed pilot in a compulsory pilotage district; that all the orders preceding the collision were given by the pilot; and that all his orders were properly and promptly obeyed. During the rest of the trial this matter was left untouched. It receded into the background, and seemed to have faded out of memory, until Mr. Aspinall, in his address in answer to Mr. Laing, dealt with it. The Elder Brethren and I were carefully watching to see whether it would be suggested to the witnesses for the *Olympic* that anyone other than the pilot was to blame. It was put forward in a vague sort of way by Mr. Aspinall, at the end of the case, that the pilot was not solely responsible for the accident: "Because he was navigating his ship upon an assumption of facts which did not exist, and he was not kept informed of the real facts." When asked who the persons were other than the pilot, whose negligence partly caused the accident, he said: "The people, I should say, who were on the bridge, or the look-out men." He referred to an answer of the pilot in which he said: "Of course, while I was taking the turn, I was certain that I should get round far ahead of her, so while I was making the manœuver round the West Bramble Buoy, I was not paying much attention to her."

Then Mr. Aspinall added: "That was all the pilot knew and no more, and if his view as to the place was entirely wrong, then he was not properly informed by the owners' servants as to what the real state of affairs was." Mr. Aspinall did not explain how the owners' servants, and which of them, could know that the pilot was not paying much attention to the cruiser, which was within his sight, and to which he had signaled; or how they, and which of them could know that the view of the pilot as to the place of the *Hawke* was wrong. Similarly, Mr. Bateson, to whom I allowed a final reply, said that his case was that neither the men looking out forward or the man looking out aft gave any information to the pilot, "and the pilot never knew, nobody on the bridge knew, that we were meeting on converging courses." I asked him if he alleged any fault on the part of Captain Smith; at first he answered; "It may be that Captain Smith was relying on the look-out man," but afterwards he said that he did allege some default on the part of Captain Smith. I then asked him: "Did you put any question to Captain Smith indicating that you were going to blame him so that he might have a chance of explaining?" Mr. Bateson's answer was: "I do not think there was any question directly put to him in that form, but he tells us what he did, and that was quite sufficient for us, when he told us himself what he did. He had not excused himself from telling the pilot what was going on. The fact was he did not know, he could not tell the pilot; he did not know." And finally he said: "The point is a want of information; the pilot was not kept informed of the real position of the *Hawke*. The pilot was the person who could and ought to have kept himself informed of this.

There is not a particle of evidence that the collision was caused partly by negligence of other persons for whose negligence the owners are liable.

It may be very desirable that the law as to the defence of compulsory pilotage should be altered. I have on previous occasions expressed my views as to that. I may add that the Departmental Committee appointed to consider the question unanimously recommended the abolition of the owners' immunity.

But it is for the legislature to make the law. My function is to declare and administer it as it now stands.

The authorities as to the existing law are clear. The collision here was due solely to the faulty navigation of the pilot, and there is not a shadow of foundation for saying that the negligence of any of the owners' servants partly caused it. The owners of the *Olympic* therefore succeed on the defence of compulsory pilotage.

I have now dealt with the whole case.

As it is one of great importance, I wish to say expressly that the Elder Brethren, who have given me assistance which I value highly, are in complete accord with all the findings which form the basis of this judgment.

The result is that the action against Commander Blunt fails, and he is entitled to judgment.

In the other action, although the collision was brought about by the negligent navigation of the *Olympic*, the pilot is solely responsible for that; and accordingly judgment must be entered for the owners of the *Olympic* upon the defence of compulsory pilotage.

NOTE.—The litigation arising out of the collision on September 20 last between the White Star liner *Olympic* and the British protected cruiser *Hawke* is not yet finished. At the first hearing the British Admiralty Court decided that the liner was entirely to blame, but that as her owners were compelled to carry a pilot through the waters in which the accident happened they were not liable to damages. The White Star Company has, however, decided to appear against the decision of the court, so that the whole affair is really still *sub judice*. Meantime, the British naval authorities have expressed their approval of everything done by the commander of the *Hawke* (William Frederick Blunt) by promoting him from the rank of commander to that of captain.—*Scientific American Supplement*, Feb. 24.

Absence Over Leave in the Fleet.

(SEE NO. 140.)

COMMANDER W. A. EDGAR, U. S. Navy.—I agree with Captain Fullam in all but minor details, both as to the cause of the evil and the remedy for it.

I have used practically the same system of punishment on the three vessels I have commanded, having first tried it when I took command of the *Dolphin* in 1906. The system met with such success that I have carried it out ever since when in command and tried to induce my captain to adopt such a scheme when I was executive officer of a battleship.

I believe that restricting a man awaiting his term of confinement is unnecessary and unjust, as it is not his fault that the brig is not vacant, and that no man should be deprived of his regular liberty except for some unusual circumstance.

As for the punishment of extra duty on the quarter-deck under arms it seems to me that the object is better attained by giving real extra duty, dirty work below that always has to done by some one; it is more disagreeable without being mortifying.

I am of the opinion that such a system of liberty and punishment for breaking liberty as adopted by Captain Fullam would be of immense value to the navy if uniformly carried out on all vessels, the proper amount of loss of pay by sentence of deck courts or summary courts to be clearly defined and to be much heavier than prescribed by the present department schedule.

Cheaper Paint for the Navy.

(SEE No. 140.)

MR. MAXIMILIAN TOCH.—The article by Mr. Henry Williams of the navy on "Cheaper Paint for the Navy," deserves the closest attention of everybody connected with the paint industry and with the government.

It would appear from the information contained in this article that Mr. Williams is the first officer connected with the navy who has the courage of his convictions and his convictions are undoubtedly based upon scientific knowledge.

The writer has been familiar with the methods and the materials used in the United States Navy for the past 25 years, and to use a comparison which savors of a pun, the navy in its paint operations has been killing sparrows with ten-ton guns.

The paint materials that have been wasted on the battleships are legion, and it took a man of the strength and character of Mr. Williams to make the necessary inovations which, by the way, are only just begun, and, if carried through successfully will save the government a vast amount of money every year.

From present indications it looks as if Mr. Williams has saved the navy, during 1911, many thousands of dollars equal to a large multiple of the amount of his salary, and the unfortunate part of the whole thing is, that he probably will never get the credit that is due him, nor the recognition that is his desert, and when the improvements and innovations which he has inaugurated are found to be working in good order, it will probably be with him as with every other earnest and honest man, his name will not be mentioned in conjunction with the excellent work that he has done.

Enlightenment and scientific management seems to be the order of the day, and scientific paint making is coming into its own. The enormous amounts of white lead, zinc oxide, red lead and turpentine that have been mis-used and mis-applied are, let us hope, forever gone by, and Mr. Williams has clearly pointed out that paint should be made of materials which will do the work for which they are intended, and it is totally unnecessary to use materials which have no other recommendation beyond their excessive high price.

I must criticise only one statement made by Mr. Williams which is, the cost of red lead. It is nearer $3.00 than $2.00 per gallon at the present writing.

I am reliably informed, that through the use of turpentine substitutes by our navy, it has already been adopted by the English navy.

Mr. Williams deserves special mention on account of his exhaustive and successful work in ship's-bottom paints.

The Hydraulic Interaction between Passing Vessels, Called "Suction."

(SEE No. 140.)

LIEUT.-COMMANDER EARLE, U. S. Navy.—This article quotes examples in which both vessels are underway. It seems not improbable that such a suction exists when, in a tideway and narrow channel, a vessel passes another which is at anchor.

When leaving Queenstown harbor on June 27, 1911, the *Iowa* was, by nature of the channel, obliged to pass quite close to starboard of the Cunard steamer *Ivernia* at anchor in the channel and riding to a strong flood tide. This steamer was drawing much more water than usual, as she had some compartments filled due to striking Daunt Rock coming into port, and was then being pumped out gradually. As the *Iowa*, proceeding at nine knots, overlapped the stern of the *Ivernia*, it became necessary to stop both screws to pass over an anchor buoy, this not appreciably affecting her speed and, on starting ahead, her steering became very difficult. Full port helm was required to keep her bow away from the *Ivernia*. It is my recollection that the starboard screw was slowed also. In all events, the *Iowa* passed much closer than was intended. At the time this was attributed more to the supposedly poor steering of the quartermaster than to anything else. I had not then read Mr. Reeves' lecture, but now believe this was also a case of such suction as he describes, the tide acting in lieu of the motion of the other vessel.

PROFESSIONAL NOTES.

Prepared by LIEUT.-COMMANDER RALPH EARLE, U. S. Navy.

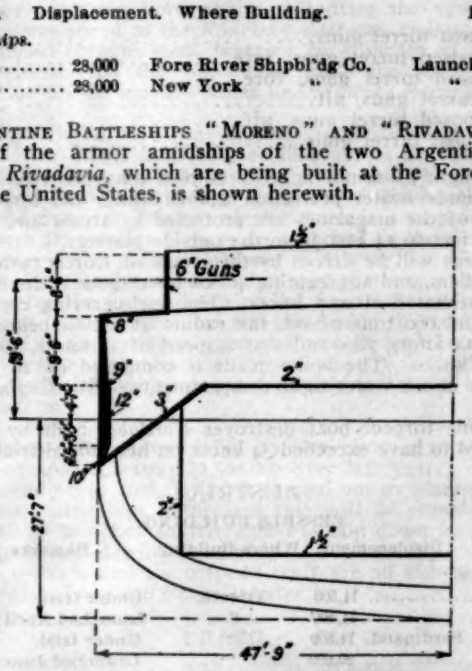
SHIPS OF WAR, BUDGETS AND PERSONNEL.

ARGENTINE REPUBLIC.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Rivadavia	28,000	Fore River Shipbl'dg Co.	Launched Aug. 26, 1911.
Moreno	28,000	New York "	" Sept. 23, 1911.

THE ARGENTINE BATTLESHIPS "MORENO" AND "RIVADAVIA."—The arrangement of the armor amidships of the two Argentine battleships *Moreno* and *Rivadavia*, which are being built at the Fore River Yard, Quincy, in the United States, is shown herewith.



ARRANGEMENT OF ARMOR AMIDSHIPS.

The *Rivadavia* was laid down on May 25, 1910, and was launched on August 26 last. The displacement of the vessel is 28,000 tons in speed trial condition, and the corresponding draft is 27.7 feet. The other dimensions are: Length, 580 feet; breadth, 95 feet 6 inches; depth, 49 feet 7 inches.

The *Moreno* and *Rivadavia* are protected by a water-line belt of armor extending from stem to stern, the thicknesses of which are: 12 inches amidship, for a length of 250 feet and a depth of 4 feet 7 inches above

and 3 feet 5 inches below the water-line, tapered down to 10-inch thickness at a depth of 5 feet 10 inches below the water-line. Fore and aft of the main belt the thickness of the water-line belt is reduced to 10 inches as far as the foremost and aftermost 12-inch gun mounting, and from these points the thickness is 6 inches forward and 4 inches aft.

The citadel armor between the armored deck and the upper deck has a height of 9 feet 6 inches and a thickness of 9 inches below and 8 inches above the upper deck for a length of 400 feet amidships. The thickness of the armor forward and aft of these points is 6 inches and 4 inches respectively.

The casemate armor extends from the foremost 12-inch barbette to the aftermost barbette, and has a height of 8 feet 6 inches and a thickness of 6 inches. The forward conning-tower is 12 inches thick, the after tower 9 inches. The thickness of the protected deck is 2 inches on the horizontal part and 3 inches on slopes.

The armament is to consist of twelve 12-inch guns, twelve 6-inch guns, and twelve 4-inch guns.

The height of the main armament guns above the water-line is:

	ft.	in.
Foremost turret guns	31	8
Superposed turret guns, fore	39	9
Starboard turret guns, fore	31	8
Port turret guns, aft	31	8
Superposed turret guns, aft	31	8
Aftermost turret guns	22	5

The total weight of armor aggregates 7600 tons, 680 tons of which are employed for under-water protection against mines and torpedoes.

The bottom of the magazines are protected by armor and situated at a distance of 13 feet to 14 feet from the outside plating.

The battleships will be driven by three sets of Curtis turbines working on three propellers, and aggregating 40,000 horse-power, the corresponding speed being estimated at 22.5 knots. The fuel-carrying capacity is 4000 tons of coal and 660 tons of oil, the radius of action being 10,500 miles at a speed of 11 knots, 7200 miles at a speed of 15 knots, 3600 miles at a speed of 22.5 knots. The boiler plant is composed of 18 Babcock and Wilcox boilers in six water-tight compartments.—*The Engineer.*

The Argentine torpedo-boat destroyer *Cordoba*, built by Schichau, at Elbing, is stated to have exceeded 34 knots on her official trial.

AUSTRIA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Radetsky	14,500	Trieste.	Under trial.
Zrinyi	14,500	"	Launched April 12, 1910.
Erzherzog Franz Ferdinand.	14,500	"	Under trial.
Viribus Unitis	20,000	"	Launched June 24, 1911.
Tegetthof	20,000	"	Building.
VI	20,000	"	Authorized.
VII	20,000	Fiume.	"

BUDGET.—The total naval estimates for 1911 amount to approximately $25,000,000.

A new naval program has been adopted by the Austrian-Hungarian delegations, which authorizes the expenditures of $63,417,200 for shipbuilding, in six installments, during the years 1911 to 1916, inclusive. With this amount there are to be constructed four battleships, three cruisers, six destroyers, twelve torpedo-boats, and six submarines. Two of these

battleships were laid down in 1910, and contracts for the other two have been awarded. Of the remaining vessels of the new program some have already been ordered, and the others will be ordered shortly.

During 1911 there was completed the battleship *Zrinyi*, of 14,271 tons displacement.—*Army and Navy Register.*

DATA OF BATTLESHIPS.—The new Austrian *Dreadnoughts*, which were at one time the subject of a brisk controversy as to their raison d'être, are similar to their Italian rivals in that they carry their guns in triple turrets. The disposition, however, of the four turrets of the *Viribus Unitis* and her sister, the *Kaiser Franz Joseph*, is like that of the *Michigan*, and so even in this early stage of triple mountings there are examples of three different methods of disposing them. In the *Dante Alighieri* they are carried on the center-line all on the same level, and the *Ganguts* exemplify the échelon disposition. On a displacement of 20,000 tons the *Viribus Unitis* carries amidships, as in German ships, a secondary battery of twelve 5.9-inch, in addition to the heavy main battery of twelve 12-inch guns, which can deliver a broadside of nearly 12,000-pound weight. Parsons' turbines of 25,000 horse-power will drive the vessel at 20 knots, which is the same speed as the *Radetsky* class can maintain. A main belt of 12-inch nickel-chrome steel, tapering to 5 inches at the ends, gives adequate protection on the water-line, while the secondary battery is mounted behind 6-inch armor.—*Naval and Military Record.*

PROGRESS IN BUILDING.—The *Armeeblatt* of Vienna states that the battleship *Viribus Unitis* is making rapid progress at Trieste, and should be in commission next September. The sister ship *IV* is also advancing, and is to be launched in the spring. It is hoped that another ship, *V*, will shortly be laid down at Trieste. Active work is also proceeding at Malfoncone, where the cruiser *G* is to be launched in the first half of 1912. She is a sister of the *Admiral Spaun*. The very considerable works at Fiume are making progress, and it is hoped that one of the large berths will be ready for the laying down of the fourth *Dreadnought*, known as *VI*, in the first half of 1912. At the same yard the cruiser *H* has been laid down, and in the auxiliary yard at Porto Re six destroyers are to be built, of which three have been laid down and are well advanced. In the numeration of the battleships two pre-*Dreadnoughts* are included.—*Army and Navy Gazette.*

NEW BUDGET.—The estimates for 1912-13 carry a total of $28,318,500, an increase of approximately $3,500,000 over last year. The shipbuilding program, extending to 1916, is being carried out as planned.

Of the four battleships authorized one will be completed during the year, one will be launched shortly, one was laid down last December, and the fourth is to laid down immediately.

The three cruisers and the torpedo craft are all either under construction or ordered.—*Army and Navy Register.*

BRAZIL.

M. Geraes	(2)	19,250	23,500 = 21	12 12-inch, 50 cal. 22 4.7 in.
Rio de Janeiro.....	(1)	28,000	= 22	14 12-inch, 50 cal. 20 6 in., 12 12 pr.

Another navy which has become more important since the commencement of the *Dreadnought* era is that of the prosperous South American State of Brazil. She caused some stir by ordering from British firms two battleships of the *Minas Geraes* class, which at the time they were laid were the most powerful ships in the world. Since then she has ordered a third vessel, which was at one time to be of 32,000 tons, and designed to mount the hitherto unsurpassed armament of twelve 14.3-inch. How-

ever, on assuming office the new President caused the designs of this ship to be altered with a view to considerably reducing the tonnage, with the result that the *Rio de Janeiro*, as she is called, will only displace 28,000 tons. The caliber of the guns remains the same as in the first pair of ships, but, as stated in the South American supplement of *The Times*, she will carry no less than fourteen of these in seven twin turrets, an unprecedented number for one-caliber ships. For protection against destroyers, this powerful main armament is supplemented by a score of 6-inch weapons, and twelve 12-pounders. The *São Paolo* and *Minas Geraes*, which were laid down in 1907 by the firms of Armstrong's and Vickers' respectively, were completed in 1910, and are in every way worthy of British designers. Although of the same displacement as the *St. Vincent*, they were designed to carry two more heavy guns, so that the broadside amounts to ten guns, which, amongst the 12-inch-gunned ships of the British Navy, can only be equalled by the three *Neptunes*. Four turrets are mounted on the center-line in two pairs superposed fore and aft, the other two being mounted singly on each beam. The innovation of superposed turrets, which was first tested in these ships, results in an ahead and astern fire of eight guns, and, as stated in the description of United States ships, is of great utility in economizing length. A strong secondary armament of twenty-two 4.7-inch, somewhat akin to the American 5-inch batteries, is disposed for the most part on the main deck, the remaining eight being in well-protected positions in the superstructure. A feature is the armor protection, which, though thinner than usual on account of the heavy offensive equipment, is very complete and uniform in thickness. For instance, the whole of the side between the extreme turrets is covered with armor 9 inches thick, which ensures the safety of the secondary armament, which in contemporary British ships is exposed to considerable risk of destruction. With reciprocating engines of 23,500 horse-power both ships easily reached their designed speed of 21 knots, the *Minas Geraes* having steamed at a best speed of 22.29 knots, which is very creditable to the constructors.—*Naval and Military Record.*

CHILI.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Constitucion	27,500	Elswick.	Laid down Nov. 1911.
Libertad	27,500	Vickers.	" " Dec. 1911.

The first piece of the ram of the famous Chilean battleship *Constitucion* was put in place at Elswick in the second week of December. This vessel will have a displacement of approximately 28,000 tons. It should be launched early in 1913, and enter the service towards the middle of 1914.

This battleship and her sister will have ten 13.5-inch guns in main battery; and sixteen 6-inch guns in her torpedo-defence battery. They will be of 45,000 horse-power, have Parsons' turbines, and make a speed of 23 knots.

FRANCE.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Courbet	23,500	Lorient.	Launched Sept. 23, 1911.
Jean Bart	23,500	Brest	" Sept. 22, 1911.
France	23,500	St. Nazaire.	Building.
Paris	23,500	La Seyne.	"

BUDGET.—The total naval appropriations for 1911 amount to $80,371,109, as compared with $72,485,000 appropriated for 1910.

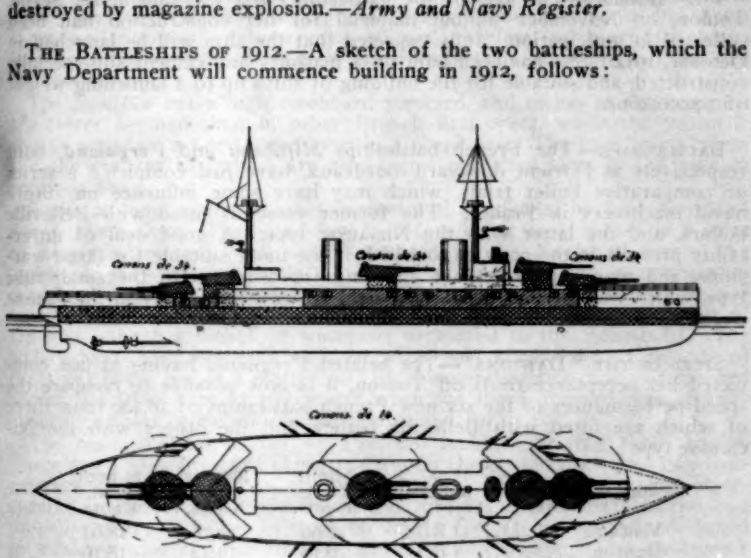
The shipbuilding program authorized for 1911 provides for the construction of two battleships, two submarines, and two mine-laying vessels. The battleships are to be similar to the *Courbet* and *Jean Bart*, authorized in 1910, of 23,100 tons displacement and a main battery of twelve 12-inch guns. The submarines are to have a submerged displacement of about 980 tons and a large steaming radius in order to be able to accompany the battle fleet.

Six battleships of the *Danton* class, 18,030 tons displacement, were completed during the year, as well as the armored cruiser *Waldeck Rousseau*, of 13,780 tons displacement. Seven destroyers of about 700 tons displacement and a number of submarines were also completed. Various experiments were made with the new submarine *Mariotte*, of 630 tons submerged displacement.

The naval estimates for 1912 have recently been submitted and amount to $82,364,302. The building program for 1912 consists of two battleships, nine submarines, and one transport.

According to press reports, the minister of marine has announced his intention of asking parliament to authorize the construction of a third battleship in order to make good the loss of the battleship *Liberte*, recently destroyed by magazine explosion.—*Army and Navy Register.*

THE BATTLESHIPS OF 1912.—A sketch of the two battleships, which the Navy Department will commence building in 1912, follows:



These battleships will have, like the *Jean Bart*, a displacement of 23,500 tons. The battery, however, will be different, and will consist of ten 13.6-inch guns mounted in five turrets, twenty-two 5.6-inch guns mounted in an armored casemate, and four under-water torpedo-tubes.—*Le Moniteur de la Flotte.*

The new French super-*Dreadnoughts* will, in their main batteries, be the equal of the English *Orion* and are superior in torpedo defence battery.

French	10 13.6-inch	22	5.6-inch
Orion	10 13.7-inch	16 to 20	4.1-inch

English constructors consider the armor belt of the French ships too far below water, and that it does not protect the decks from oblique fire.

The *Orions* are, however, in service three years ahead of these French ships.

THE NEW FRENCH BATTLESHIPS.—The *Moniteur de la Flotte* publishes a diagram showing the plan of the two battleships which the Ministry of Marine hopes to lay down in 1912. The design resembles in many ways that of the *Jean Bart* and *Courbet*, but there is an an important change in the matter of armament. Instead of twelve 12-inch guns, the ships will mount ten of 13.4-inch, all in double turrets on the middle line. The guns forward and abaft will be mounted as in the earlier ships, and will have about the same arc of training, being some 135 degrees, and probably a little more for the upper guns. Amidships, instead of two turrets on either broadside, will be one on the middle line mounting two of the new guns, and having an arc of fire of perhaps 100 degrees on the broadsides. There will also be twenty-two 5.5-inch guns mounted as in the other ships. The displacement will be about the same, namely, 23,500 tons. There have been labor troubles both at Lorient and Brest, and at the latter port electric wires were cut in the *Jean Bart*, whereby it appears some men were injured. The *France* has been put in hand at Lorient, and the *Paris* at the Chantiers de la Seyne, Toulon.—*The United Service Gazette.*

THE "PARIS."—The keel of the battleship *Paris* was laid at La Seyne, Toulon, on November 30, but material for her construction had been collected in anticipation. It is expected that the ship will be launched in October, 1912. She has been built on a masonry and cement slip specially constructed, and suitable for the building of ships up to a launching weight of 10,000 tons.

BATTLESHIPS.—The French battleships *Mirabeau* and *Vergniaud*, built respectively at l'Orient dockyard Bordeaux, have just completed a series of comparative boiler trials, which may have some influence on future naval machinery in France. The former vessel is fitted with Belleville boilers, and the latter with the Niclausse type. A good deal of uncertainty prevails in the navy as to which is the more suitable for large warships, and many engineers are agitating for a return to the small tube type, which was fitted in some of the earlier vessels, notably in the *Jeanne d'Arc*, *Chateaurenault*, and *Montcalm*.—*The Engineer.*

SPEED OF THE "DANTONS."—The belated *Vergniaud* having at last completed her acceptance trials off Toulon, it is now possible to compare the speed performances of the six new French battleships of 18,400 tons, three of which are fitted with Belleville boilers and the others with the Niclausse type:

Ships.	Boilers.	3-hour trial. Knots.	10-hour trial. Knots.	24-hour trial. Knots.
Voltaire	(B.)	20.66	19.78	18.63
Danton	(B.)	20.18	19.44	18.16
Mirabeau	(B.)	20.18	19.73	18.27
Diderot	(N.)	19.9	19.48	18.4
Condorcet	(N.)	19.7	19.31	18.02
Vergniaud	(N.)	19.63	19.2	17.74

As only 19.25 knots at full power and 17.5 for 24 hours had been stipulated, the results obtained must be pronounced satisfactory, all the more so as the *Dantons* proved, during the summer maneuvers, their aptitude for easy steaming at 17 and 17.5 knots. The ships fitted with Belleville's have been specially successful, the *Voltaire*, for instance, developing up to 29,657 horse-power, and reaching 21.2 knots. These performances afford good ground for hope that the *Bart* (Belleville) and *Courbet* (Niclausse boilers), now completing, will substantially exceed their stipulated speed of 20 knots, and rival the German *Helgolands* that have just done from 21 to 22 knots.—*Naval and Military Record.*

THE FRENCH DESTROYER "BOUCLIER."—The French destroyer *Bouclier* was recently handed over to the French Admiralty by the firm of A. Normand & Co., which built her. This vessel is the first among the numerous craft built at the Normand yard to be fitted with Normand boilers fired only with liquid fuel. The burners employed are of a type patented by the firm. The *Bouclier*, which was engined by the Cie. Electro Mécanique, of Le Bourget, near Paris, has the following particulars:

	ft.	in.
Length over all	233	4
Length between perpendiculars	23	4
Extreme breadth outside plating	24	10
Depth	16	5
Mean draft	12	6
Displacement on trials	660.44 tons.	

The hull is of high tensile steel, galvanized in the upper works. It is divided into ten water-tight compartments. The hull is clincher riveted, the stem is of forged steel, and the sternpost, etc., of cast steel. The vessel is divided as follows: From forward aft: Collision compartment, crew's quarters with chain locker underneath, ammunition room and store-room, boiler-rooms, engine-rooms, officers' quarters, petty officers' quarters, and store-room. The deck is covered with linoleum and wooden battens.

The *Bouclier* has a high freeboard forward, and owing to this the men are better berthed than in other French destroyers, while the vessel is able to maintain a good speed even in a rough sea. The navigating officer and the man at the wheel are also better protected than is the case in previous boats.

Steam is supplied to the main engines and auxiliaries by four Normand water-tube boilers. The liquid fuel is, before being used, heated in a form of heater which has been newly patented by the Normand firm. The boilers have a heating surface of 5277 square feet and a combustion chamber of 386 cubic feet capacity. The safety valves are set at 228 pounds per square inch, and at full power an air pressure equal to that of 110 mm.—about 4 inches of water—is permitted in the stoke-hold. The boilers have been designed each to burn 3300 kilos (=7273 pounds of fuel) per hour, but as a matter of fact this consumption was not reached during the trials even at full power when the speed attained was actually about 4½ knots in excess of that contracted for.

The main engines consist of Parsons' turbines driving three shafts. There are a high-pressure ahead turbine on the center shaft and two low-pressure ahead turbines on the wing shafts. Astern turbines are incorporated in the casings of the two latter turbines. Each shaft carries one propeller, 5 feet 3 inches in diameter and 4 feet 11 inches pitch, designed to work at 1000 revolutions per minute at full power. The condensers have a cooling surface of 11,682 square feet, and a vacuum of 700 mm. was guaranteed. The four Normand boilers have a heating surface of 21,108 square feet, and the cubic capacity of the furnaces is 1544 cubic feet. Each boiler has nine burners.

The following are the results of the official trials:

Six Hours' Full-power Trial.

Displacement at start	650.44 tons
Average mean steam pressure	217 lb.
Average mean steam-chest pressure	183 lb.
Average air pressure in stokeholds	109 mm.
Pressure in liquid fuel burners	143 lb. per square inch
Revolutions per minute, mean	1034.2
Mean speed for six hours	35.334 knots
Contract speed	31.0 knots

Six Hours' Full-power Trial.—Continued.

Shaft horse-power	15,000
Vacuum at condenser	700 mm.
Consumption of fuel per hour	21,912 lb.
Consumption permitted by contract	29,193 lb.
Consumption per square foot of heating surface	1.038 lb.
Consumption per horse-power hour	1.46 lb.

Eight Hours' Consumption Trial.

Displacement before trials	659.446 tons
Mean draft	1 .6 ft.
Mean steam pressure at boilers	2.4 lb.
Revolutions per minute, mean	325.19
Mean speed for eight hours	14.06
Mean speed as per contract	14.00
Shaft horse-power	1400
Vacuum at condensers	730.3 mm.
Consumption of fuel per hour	1915 lb.
Consumption of fuel per horse-power hour	1.37 lb. (nearly)

The shaft horse-power was ascertained by means of a Hopkinson-Tring tortiometer.

The *Bouclier* has up to the time of writing proved herself to be the speediest and most economical vessel of her class, and her performances are certainly excellent. Her armament consists of four 18-inch torpedo-tubes. Six torpedoes are carried. There are two 4-inch quick-firing guns, one forward and one aft, and two 2.5 quick-firers, two forward and two aft, one on each side. Four hundred and fifty shells are provided for each gun.

The fuel-bunker capacity is of such dimensions that the fuel which can be carried permits of a radius of action at 14 knots of 1950 miles.—*The Engineer.*

SUBMARINES.—The only new particulars which appear in the annex as to vessels to be constructed in the dockyards concern the submarines, which are to be designated *Q 94* to *Q 101*. With the exception of the last, all will displace 410 tons, and will be 181 feet long, with 16 feet 9-inch beam; they will have 1300 horse-power, a speed on the surface of 15 knots, and a complement of three officers and 24 men. *Q 102* will be a little larger, the intended displacement being 520 tons, the length 196 feet 9 inches, the beam 17 feet 9 inches, the surface speed 17½ knots, and the complement numbering two additional men. The *Gustave Zédé* and *Néréide*, which are under construction, are larger vessels—797 tons, 4800 horse-power, and 20 knots on the surface.—*Army and Navy Gazette.*

On September 22 there was launched at St. Nazaire a submarine salvage vessel for the French Navy. This vessel is 328 feet long, 87 feet 3 inches in extreme width, and displaces 1500 tons. For the greater part of its length the hull is divided into two parts, with a space of 42 feet 8 inches between them, and over this are erected ten girders with the necessary electrically operated machinery for raising a submarine up to 1000 tons. A very serious drawback to the vessel's utility is that she will have no motive power, and will thus be exceedingly difficult to manage in a seaway.—*Journal of the Royal Artillery.*

PROGRAM FOR 1912.—The budget recently submitted to parliament carries a total appropriation of $88,364,302 and provides for laying down two battleships, nine submarines, and one transport. It is likely that a proposal to authorize a third battleship, to replace the *Liberte*, will meet with favorable consideration.—*Army and Navy Register.*

GERMANY.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Oldenburg	22,400	Danzig (Schichau).	Launched June 30, 1910.
Kaiser	24,000	Kiel (Kaiserliche W.).	" Mar. 22, 1911.
Friedrich der Grosse	24,000	Hamburg (Vulkan).	" June 10, 1911.
Kaiserin	24,000	Kiel (Howaldt).	" Nov. 11, 1911
König Albert	24,000	Danzig (Schichau).	Building.
Prince Regent Luitpold	——	Germania Works.	"
Ersatz K. Friedrich Wilhelm	——	Hamburg (Vulkan).	"
" Weissenburg	——	Bremen (Weser).	"
" S	——	Wilhelmshaven.	"
Armored Cruisers.			
Goeben	22,600	H'b'rg (Blohm & Voss).	Launched Mar. 28, 1911.
J	25,000	"	Building.
K	25,000	"	Authorized.
Protected Cruisers.			
Breslau	4,500	Stettin (Vulkan).	Launched May 16, 1911.
Magdeburg	4,500	Bremen (Weser).	" May 13, 1911.
Stralsund	4,500	Bremen (Weser).	" Nov. 4, 1911.
Ersatz Strassburg	4,500	Wilhelmshaven.	" Aug. 24, 1911.
" Seeadler	4,500	Germania Works.	Building.
" Geier	4,500	Howaldt.	"

THE GERMAN NAVY ESTIMATES.—These have now been published in the *German Press*, and show that provision has been made for the second installment of the cost of three battleships and one cruiser which belong to the financial year 1911, for the third installment of the cost of three battleships and one cruiser which belong to the 1910 financial year, and for the fourth installment of the cost of three battleships and one cruiser which belong to the financial year 1909. The program for which a first installment is to be provided in 1912 includes one battleship, the *Ersatz Brandenburg*, and one cruiser, the *Ersatz Kaiserin Augusta*. Provision is also made for two small cruisers, and for the first installment of the cost of a torpedo-boat flotilla. The sum for submarines remains the same as last year—*i. e.*, £750,000. A sum of £150,000 will be provided towards the cost of the new Admiralty building, Berlin. For keeping the ships in commission a sum of £175,850 in excess of last years' amount is provided, an excess which is said to be due to a more extensive commissioning of large units; this leads also to an excess of £118,150 in the provision for ammunition as compared with last year.

The total naval estimates for 1911-12 amount to $107,232,000, as compared with $106,320,000 for the preceding year.

The naval appropriation bill for 1911-12 authorized the following new construction: Three battleships, one armored cruiser, two scout cruisers, 12 torpedo-boat destroyers, three surveying vessels, and $3,570,000 for submarine-boat construction and experiments.

During the year 1911 there were completed the battleships *Ostfriesland*, *Helgoland*, and *Thuringen*, having a displacement of 22,440 tons and carrying twelve 12-inch guns; also the armored cruiser *Moltke*, of 22,640 tons displacement and carrying ten 11-inch guns.

DATA ON GERMAN BATTLESHIPS.—The following table gives the classes and principal features of German battleships and armored cruisers de-

signed so far. The figure in brackets after each name indicates the number of vessels belonging to that class:

GERMANY

	Tonnage	Designed I. H. P. Speed	Armament	Broadside (pounds)
BATTLESHIPS—				
Nassau.....(4)	18,500	20,000=19.5	12 11-in., cal. 12 5.9-in., 16 24-pr.	6,080
Helgoland...(4)	22,800	25,000=20	12 12.2-in., 45 cal. 14 5.9-in., 14 24-pr.	7,848
Kaiser.....(4)	24,000(?)	27,000=20	12 12.2-in., 45 cal., 14 5.9-in., 14 24-pr.	11,772
Ersatz Odin..(4)	25,000(?)		10 14-in.	
ARMORED CRUISERS—				
Von der Tann (1)	19,000	44,000=25	8 11-in., 45 cal., 10 5.9-in., 16 24 pr.	6,080
Moltke.....(3)	23,000	80,000=25.5	10 11-in., 45 cal., 12 5.9-in., 12 24-pr.	7,600
"K".....(1)	(?)	90,000(?)=28	8 14-in.	

German battleships are now divided into classes of four each, and at present there are sixteen *Dreadnought* battleships completed, under construction, or preparing to build. In spite of the large armament of the first eight ships of the *Nassau* and *Helgoland* types, it is true that out of twelve heavy guns, only eight can be brought to bear on each broadside. In the *Nassaus* the 11-inch 45-caliber weapons are mounted in six turrets, one forward and one aft and four at the corners of the superstructure. Thus the ahead and astern fire is from six guns, and if attacked on both sides at once these ships would be able to reply with six guns on each broadside, which is very satisfactory—provided that the enemy obliges by making such an attack.

Associated with the heavy main armaments, these ships, like all the German *Dreadnoughts*, carry a battery of 5.9-inch quick-firers on the main deck behind armor, the *Nassaus* mounting ten, and the *Helgolands* twelve. In addition, for beating off destroyers there are sixteen 24-pounders, disposed in pairs in the superstructures, and on the main deck forward and aft, in the *Nassau* class; two less in the *Helgolands*. The displacement of the *Nassau* and her three sisters is 18,500 tons; their length is only 470 feet, but the beam—characteristic of German *Dreadnought* battleships—is as large as 89 feet. That of the *Helgoland* is 93½ feet, and the increase of length is 76 feet, the resulting large displacement of 22,800 tons being necessary to carry the armament of 12.2-inch guns with which these ships are equipped. These guns fire a heavy shell of 981 pounds with much the same degree of penetration as the British 50-caliber 12-inch. They will probably be superseded in the *Ersatz Odin* and later ships by the new 14-inch weapon, and so only one division of eight ships will be armed with them. The *Kaiser* class, of which two have already been launched this year, will almost certainly have their guns disposed in five turrets, as in the *Neptune* and *Moltke*. There is some doubt as to whether there will be ten or twelve, but it is possible that the forward and aft turrets will be triple, enabling twelve guns to be mounted as in previous ships. This disposition is most praiseworthy, as one of the objections to 12-gun ships has been overcome by having only five turrets, and so avoiding undue interference. Again, the employment of the triple turret, which presents a large target and if disabled involves a considerable loss of offensive power, is not overdone to the extent of some foreign designs. The *Kaiser* class, which displaces about 24,000 tons, are credited with the same secondary and mosquito armaments as the *Helgolands*. Moreover, the fourteen 5.9-inch of the main-deck battery appear to be somewhat higher above the water than in previous ships, and so less likely to be made unserviceable in a seaway. The design of the first ships to mount the

14-inch gun shows that the ten guns are apparently disposed in two triple and two twin turrets, arranged as in the *Michigan*, with the latter naturally superposed. Included in the armament, however, in addition to the main-deck battery of twelve 5.9-inch, is a medium armament of eight 8.2-inch in four twin turrets at the corners of the superstructure. It is difficult to see the reasons for the adoption of these weapons. Presumably they are intended for the attack of armored ships, as at 5000 yards the 8.2-inch of 45 calibers can penetrate about 9 inches of Krupp armor, and at longer battle ranges they might, with their comparatively rapid rate of fire, be effective against lightly protected armored cruisers. Their use against large destroyers seems unnecessary owing to the presence on the same ship of quick-firing 5.9-inch of much greater handiness.

The German battleship-cruisers are of three types, and so far those completed or under construction number five. The *Von der Tann* is in a class by herself, and is a fine vessel of 19,000 tons and 28 knots trial speed, carrying an armament of eight 11-inch 45-caliber and a secondary battery of ten 5.9-inch, supplemented by sixteen 24-pounders, mounted as in the *Nassau* class of battleships. Her main armament is arranged like that of the *Indefatigable*, but the starboard turret is écheloned forward, instead of the port turret as in that ship; the only criticism against the German ship is that the main-deck battery is too near the water, a defect which could have been remedied by prolonging the forecastle deck as far aft as the port turret, and so having three out of the four turrets on the same level. In the design of the *Moltke* and her two splendid sister ships, the *Goeben* and *J*, which has only lately been begun at Hamburg, the design is much improved. The ten 11-inch are arranged so that the additional turret fires over the stern guns, four of the turrets being on the level of the forecastle, so that the dozen 5.9-inch of the secondary battery are well clear of the water. The four 24-pounders carried in the *Von der Tann* on the main deck astern have in these ships been suppressed, leaving only twelve. The design of the 14-inch-gunned cruiser *K* is similar to that of the battleships which mount the new gun, with the exception that all four turrets are twin mountings. As in the *Ersatz Odin* class, the 8.2-inch appears, and the customary battery of 24-pounders is abandoned. It is noteworthy that in the interests of homogeneity the 12.2-inch has not been adopted for armored cruisers.—*Naval and Military Record.*

NEW BATTLESHIPS.—The German battleship *Ersatz Hagen*, laid down in November, 1910, was launched at the Howaldt yard, Kiel, on November 11. The vessel was named *Kaiserin*, and will form a homogeneous group with the *Kaiser*, *Friedrich der Grosse*, and *Konig Albert* (*Ersatz Aegir*).

Orders for the German armored ships of the 1911 program have been placed, but there is as yet no information as to the date of laying down. One battleship will be built at Wilhelmshaven, at the Weser yard, Bremen, and at the Vulcan yard, Hamburg; while the cruiser *K* will be built by Messrs. Blohm & Voss, at Hamburg. The last-named firm has built all Germany's cruiser-battleships and seven of the thirteen armored cruisers built and building.—*Journal of the Royal Artillery.*

DELIVERY OF SHIPS.—The ships of the program of 1909 to be delivered in 1912 are three battleships: the *Oldenburg*, the *Kaiser*, the *Friedrich der Grosse;* the cruiser-battleship *Goebin*, and two small cruisers, *Breslau* and *Magdeburg*. During the year 1911, five ships were delivered the last being the *Moltke*.

RESULTS OF SPEED RUNS.—The battleship Helgoland has proved to be the fastest in the fleet. She has maintained a speed of 22 knots, while her sister ships, the *Thüringen* and *Ost Friesland*, have done 21.1 and 21.3 respectively.

The cruiser-battleship *Moltke*, fitted with Parsons' turbines, made, over the measured mile at Danzig, a speed of 29.7 knots.

NEW BRITISH AND GERMAN BATTLESHIP CRUISERS—"LION" AND "MOLTKE."—To compare the *Lion* with the *Moltke* is very much like drawing a comparison between the *Dreadnought* and *Lord Nelson*—the ships are contemporaries only in name, and really belong to two different eras of warship design. That this should be the case reflects both credit upon our construction staff and saddles the Wilhelmstrasse authorities with distinction of a somewhat opposite order, for while the *Lion* may be regarded as a cruiser edition of the *Orion*, the *Moltke* is more or less related to the *Neptune* class which preceded the 13.5-inch gunned ships, and is more comparable to the *Indefatigable*.

Both ships are, however, entering into service about the same date, and as examples of the latest work in battle-cruisers on both sides of the North Sea, make a comparison reasonable.

In design the ships represent totally different schools of thought, for whereas the British ship carries all her guns along the center-line and mounts 13.5-inch and 4-inch guns, her German "opposite number" follows the *en echelon* example of distribution—now almost universally abandoned—plus center-line, and carries 11-inch, 5.9-inch and 3.4-inch pieces. The pros and cons of each can best be discussed separately, and we will therefore first examine the characteristic features of the *Lion*.

The general outline of the ship can be seen from the plan and illustration. She is an *Orion* with the super-firing guns aft sacrificed, and her protection decreased for the gain of probably eight knots in speed. In order to accommodate the immense engine and boiler power her dimensions show a great increase over previous battle-cruisers, being: Length over all, 720 feet; beam, 88½ feet; and draft, 27 feet; giving her a displacement of 26,360 tons against the 18,750 tons of the 580 feet × 80 feet × 26½ feet *Indefatigable*. Her main armament consists of eight 13.5-inch guns, those in the second turret forward firing over the first pair, with a couple amidships, and also upon a lower deck level aft. These immense guns fire a 1250-pound projectile with a muzzle velocity of 2821 foot-second, and exert an energy of 69,000 foot-tons, are 45 calibers in length and weigh 76 tons. Her total weight of discharge compared with *Moltke's* works out as follows:

Guns.	*Lion.*	*Moltke.*
Ahead	4 13.5-inch = 5,000 lbs.	6 11-inch = 4,560 lbs.
Astern	2 13.5-inch = 2,500 lbs.	8 11-inch = 6,080 lbs.
Broadside	8 13.5-inch = 10,000 lbs.	10 11-inch = 7,600 lbs.

which gives the German ship a superiority when fighting astern only, while the advantage of greatly increased range and localized smashing power is with the *Lion*.

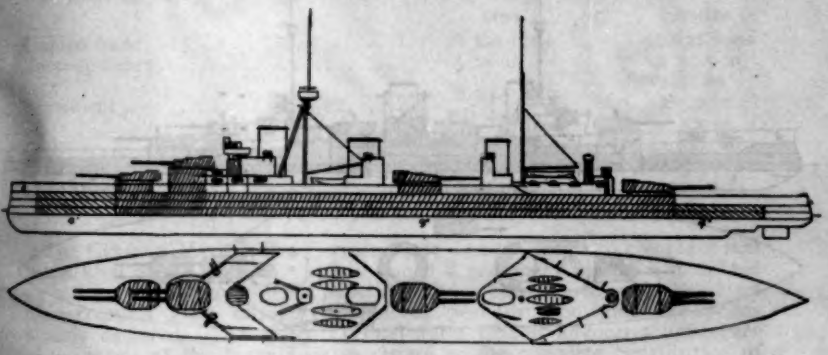
The disposition of the *Lion's* guns is perhaps not the best that might have been adopted. The amidship guns certainly have wide angles of fire, but by bringing them aft as in the Japanese *Kongo*, the concentration in the astern axial line could have been increased. This alternate arrangement is the one which has probably been utilized in the *Queen Mary* class.

The structures around the funnels are 2-inch blast-screens, which are designed to protect them from the firing effects of this pair of guns, and, from the angle at which they are set, to deflect small projectiles which might otherwise hole the uptakes, and so reduce speed, and enveloping the decks with smoke, make gun-setting difficult. Being clear of the quick-firing guns they have also been fitted to carry searchlights, the old idea of grouping guns and projectors on to bridges, etc., having been discarded in favor of keeping the latter well away from the shock and smoke of the 4-inch quick-firing pieces.

The anti-torpedo-boat armament of the *Lion* consists of sixteen 4-inch guns, firing a 31-pound projectile. Eight of these are up forward in the superstructure, and eight aft along the boat-deck, being so arranged that a good fire can be brought to bear on any given quarter. Compared with

the *Moltke's* secondary batteries of twelve 5.9-inch and twelve 3.4-inch weapons, the *Lion* appears undergunned as regards this portion of her equipment, and apart from any official assurances to the contrary, we have always regarded the secondary armament of our *Dreadnoughts* as their most unsatisfactory feature.

The *Lion's* 4-inch guns are unprotected except by thin screens and will obviously be all put out of action during the first half-hour of big-gun engagement, leaving the ship defenceless against the torpedo attack during the night following—a course adopted by the Japanese with the most disastrous results to the remnants of the Russian fleet which remained after Tsushima. It may, therefore, be argued that unless secondary guns are going to be protected by armor sufficiently thick to keep out the biggest projectiles, they may as well remain unprotected, medium plates such as the *Moltke* carries along her main deck being very little better than our own shields. This must be granted, and the question therefore arises "what constitutes an efficient secondary armament and how can it be economically protected?" If destroyers had not grown to the size of small cruisers, the 4-inch gun carried on a disappearing mounting so that it could be stowed away during action in an armored tube running down to behind thick armor would have been sufficient. But in these days of



PLAN OF H. M. S. "LION."

1000-ton boats, a 5-inch or 6-inch gun seems the only practicable defence, and these must be so disposed that the normal armor of the main or upper decks can be utilized to protect them, and this must have a thickness of at least 9 inches to 10 inches. That some such arrangement will be embodied in the ships of the forthcoming estimates is practically certain.

At the time of writing the *Lion* has not yet been on trial, so that the palm of being the fastest large ship afloat must be retained by the *Moltke pro tem*, she having reached 29.5 knots on trial. That the British ship will reach 30 seems taken for granted, and with engines of 70,000 horse-power capable of developing probably 100,000, it is more than likely that the German figures will be substantially improved upon.

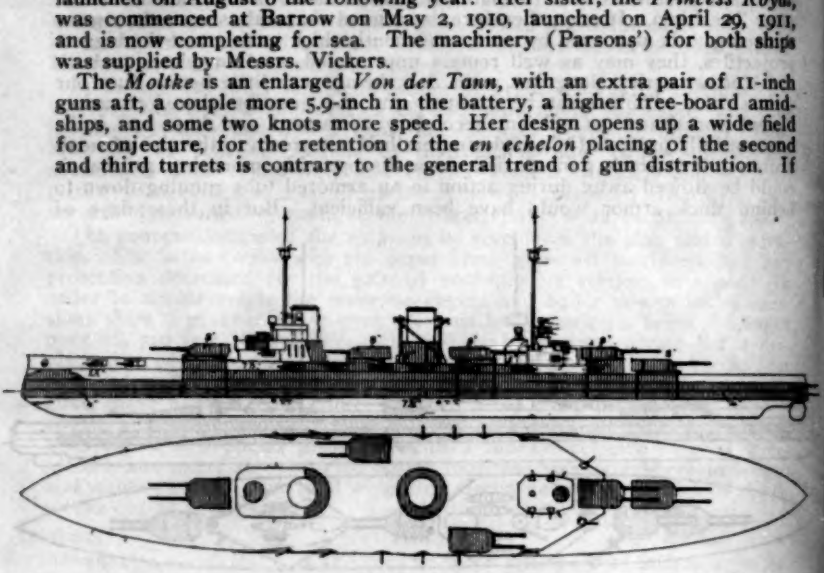
Great secrecy has been maintained over the protection and armor distribution, so that the following figures cannot be regarded as absolutely "officially" correct, although given by the most recent text-books. The main belt extends to about 20 feet of the extremities and has a maximum thickness of 9¾ inches, while the strake along the lower deck side is 7 inches—8 inches amidships, both belts tapering fore and aft to 4 inches. The entry forward is so fine that the continuation of the belt right up to the bow would have imposed too much strain on the structure; the hull is therefore subdivided fore and aft into many water-tight cellulose compartments constituting a thoroughly efficient substitute for the armor. The big gun turrets have 10-inch protection, and a 3-inch deck encloses the vitals of the ship.

In appearance the *Lion* is quite distinct from any other ship afloat. Her three funnels are all of different dimensions, the foremost being raised well above the bridge, while the third, although of the same height as the second, is thinner and rounded instead of oblong.

The water-tight aerials are suspended from the flying topmast of the tripod to the pole mast aft. Unlike the *Orion* there is no armor wall round the boats, although amidships they are partially stowed behind the funnel screens.

The *Lion* was laid down at Devonport on November 29, 1909, and launched on August 6 the following year. Her sister, the *Princess Royal*, was commenced at Barrow on May 2, 1910, launched on April 29, 1911, and is now completing for sea. The machinery (Parsons') for both ships was supplied by Messrs. Vickers.

The *Moltke* is an enlarged *Von der Tann*, with an extra pair of 11-inch guns aft, a couple more 5.9-inch in the battery, a higher free-board amidships, and some two knots more speed. Her design opens up a wide field for conjecture, for the retention of the *en echelon* placing of the second and third turrets is contrary to the general trend of gun distribution. If



PLAN OF THE "MOLTKE."

the idea finds so much favor, why was it not adopted for the *Helgoland* class? The most probable explanation is that some attempt at homogeneity with the *Von der Tann* was sought after, so that that ship, with the *Moltke* and *Goeben*, should form a tactical unit, an excuse, also, for the mounting of 11-inch instead of 12-inch guns. Whatever may have been the reasons that led to the construction of two ships carrying a main armament of 11-inch guns when rivals were putting 13.5-inch into their ships, the fact remains that the German Navy will have no battle-cruisers capable of tackling the *Lion* for some years to come.

The dimensions of the *Moltke* are as follows: Length 610 feet, beam 96¼ feet (the widest that has yet been given a warship), and draft 27 feet, giving a displacement of 22,632 tons. Her five turrets are placed: one forward, on the forecastle, two *en echelon* amidships, the starboard being the foremost, and two astern, super-firing—an arrangement practically identical to that of the *Neptune*. The twelve 5.9-inch are disposed along the main deck, the grouping on the two sides being two forward of the starboard turret and four abaft it, and five forward and one abaft the port. These are behind 5-inch armor. The twelve 3.4-inch are carried in the bows and on the two superstructures, one being placed just below the super-imposed turret. Incidentally, this gun does not show up well in current photographs of the ship, but the port is quite a large one, and

when the writer inspected the ship at Hamburg last July, the first impression was to regard it as a 5.9-inch emplacement, and credit the *Moltke* with fourteen of these guns. These 3.4-inch throw a 24-pound projectile at the rate of twelve a minute, and although mounted to repel anti-torpedo-boat attack, will probably be of little use except against small craft.

With a designed horse-power of 50,000, the *Moltke* has already reached over 29.5 knots, her power having worked up to somewhere in the region of 85,000 horse-power. Her lines are particularly fine despite her huge beam, the bow flare being very pronounced. It will be noted that the 3.4-inch guns there are not sponsoned as in *Von der Tann*, an amelioration that has improved the "dryness" forward.

Details of her protection can be gathered from the plan. The belt is 7½ to 8-inch amidships, tapering to 4-inch bow and stern, the lower deck side 5 inches and battery ditto, while the turrets have 8-inch walls.

A prominent feature of the ship is her immense funnels, with their wide, sloping bases—probably armored, although details on this point are lacking. Like the new battleships, she carries torpedo-nets along the main deck.

The *Moltke* was laid down in April, 1909, launched April 7, 1910, and is now entering service. Comparative features as as follows:

	Lion.	*Moltke*
Displacement	26,360 tons	22,632 tons
Torpedo-tubes	5 21-in	4 19.5-in.
Armament	8 13.5-in. 16 4-in.	10 11-in. 12 5.9-in. 12 3.4-in.
Cost	£2,100,000	£2,380,000
Cost per ton	£79.5	£105.1
Coal supply	1000/3500	1000/3100

—*The Marine Engineer and Naval Architect.*

THE GERMAN NAVY.—The German Navy League seems to complain that it has been misunderstood. It has issued a statement in which it defines its policy. Its pronouncement appears to have been issued with the object of correcting some misapprehension or perhaps modifying the policy already declared. The Navy League states that it advocates adherence to the terms of the Navy Law in regard to the complete constitution of the reserve fleet. This provision would not affect the program so far as it relates to the building of battleships, and is probably intended to ensure better training for men. The only change proposed by the League has relation to the construction of the large cruisers or battle-cruisers, of which the legal establishment is 20. Of these 11 are now completed, including two of the *Dreadnought* class, three others are in hand, and a fourth will be provided for in 1912. This would leave five others to be built, which would be laid down under the law at the rate of one each year. The proposal of the Navy League is that they shall be built in half the time, by laying down two each year instead of one. Thus the last pair of the series would be laid down in 1914. The German League adds that a policy of two-keels-to-one, if adopted by this country, would not be alarming, because 20 ships to 40 would be more powerful than four ships to eight. The proportion would be the same, but, according to the German critics, the effect would be greater.

NEW PROGRAM.—The estimates for 1912-13, recently submitted to the Reichstag, amount to $111,254,589. The provisions for new ships are exactly according to the program laid down in the fleet law and provide for the laying down of one battleship to replace the *Brandenburg* and one battle-cruiser to replace the *Kaiserin Augusta*, two scout cruisers, twelve destroyers, one submarine salvage ship, and a sum of $3,570,000 (same as last year) for submarine-boat construction and experiments. There is an

increase in the estimate for maintenance for ships in commission, due partly to the increased size of units and to larger crews and partly to the proposal to establish a third battleship squadron in full commission. This means the keeping in commission of a battleship fleet composed of one fleet flagship and three squadrons of eight ships each, or twenty-five battleships.

A proposal much voiced in the press of late and meeting with popular approval is to accelerate the replacement of the six older large cruisers, laying down their substitutes at the rate of two per year instead of one, as provided in the fleet law.

As usual, there is an increase in personnel to meet the increased needs of the service. Provision is made for 145 additional officers and 3549 enlisted men.—*Army and Navy Register.*

SPEED OF SMALL CRUISERS.—The German cruiser *Stralsund*, which was launched recently, is expected to attain a speed of "nearly 30 knots," and her reported horse-power of 30,000 is 5000 units greater than that for which the *Chatham* has been designed. But then the *Stralsund* is smaller by nearly 1000 tons, and carries a less powerful armament of two 5.9-inch and ten 4.1-inch guns. She is the fourth German protected cruiser to be launched during the present year, the others being the *Magdeburg*, on May 13; the *Breslau*, on May 16; and the *Strassburg*, on August 24. The two first named belong to the 1909 program, and the others to that of 1910, but all four are being built simultaneously and are understood to be of the same type.

FLOATING DOCK.—The German Navy Estimates for 1912 provide, inter alia, for a floating dock for Wilhelmshaven, the dimensions to be similar to those of the dock recently installed at Kiel. This dock is so immense that ample room remains even when one of the *Helgolands* or the *Moltke* is in position. This addition will bring the number of large ship docks at the North Sea yard up to seven, in addition to which the two locks of the new harbor entrance are convertible into dry basins for the very largest vessels. Yet another enormous floating dock is to be built for Brunsbüttel, at the North Sea end of the Kiel Canal, an establishment which is steadily growing in importance. Other floating docks, capable of accommodating *Dreadnoughts*, are to be found at Hamburg, and would be available for war purposes. When the present program has been completed Germany will possess at least twelve so-called *Dreadnought* docks on the North Sea coast.—*Naval and Military Record.*

GREAT BRITAIN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Monarch	22,500	Armstrong.	Under trial.
Conqueror	22,500	Beardmore.	Launched May 1, 1911.
Thunderer	22,500	London (Thames Iron Works).	" Feb. 1, 1911.
Ajax	23,500	Scotts (Greenock).	Building.
Audacious	23,500	Cammell, Laird & Co.	"
Centurion	23,500	Devonport.	Launched Nov. 18, 1911.
King George V	23,500	Portsmouth.	" Oct. 9, 1911.
Centurion	25,000	"	Building.
Queen Mary	28,850	Devonport.	Ordered.
3		Beardmore.	"
4		Vickers.	"

VESSELS BUILDING.—Continued.

Name.	Displacement.	Where Building.	Remarks.
Armored Cruisers.			
Lion	26,350	Devonport.	Under trial.
Princess Royal	26,350	Vickers.	Launched Apr. 29, 1911.
Australia	18,800	Brown & Co.	" Oct. 25, 1911.
New Zealand	18,800	Fairfield.	" July 1, 1911.
Queen Mary	26,350	Palmer (Jarrow).	Building.
1			Authorized.
Cruisers.			
Amphion	3,400	Pembroke.	Launched Dec. 4, 1911.
?	3,400	"	Building.
Southampton	5,400	Brown & Co.	"
Dublin	5,400	Beardmore.	"
Sydney	5,400	London & Glasgow Co.	"
Chatham	5,400	Chatham.	Launched Nov. 9, 1911.
Melbourne	5,400	Cammell, Laird & Co.	Building.
1	5,700		
2	5,700		
3	5,700		

BUILDING PROGRAM.—Now that orders have been placed for two of the three contract-built ships provided for under the current program there are no fewer than 21 ships of the *Dreadnought* type under construction in this country. Seventeen of these are British, and among them are included three ships which are engaged on or have completed their trials—the *Orion*, *Lion*, and *Monarch*—and four which have not yet been laid down. A fifth vessel remains to be ordered under the 1911 program. Four foreign ships increase the total considerably, one being under construction for Japan, Brazil, Chili, and Turkey, while each of the two last-named powers has a ship on order. The total number building and ordered, or about to be ordered, is therefore 24, but no fewer than six of these will have been completed by the end of March next, another two (the colonial cruisers) by the summer, and four of the five ships of the 1910 program early in January, 1913, in addition, probably, to the Japanese cruiser *Kongo* and the Brazilian battleship *Rio de Janeiro*. By the spring of 1913, therefore, only nine of these 24 ships will remain in the builders' hands. As opposed to this, however, there are factors on the other side to be taken into consideration. In the first place there is our own program for the coming financial year, which, according to the various "forecasts" that are now the fashion, may include anything from three to six armored units. Further, it has recently been announced that the Spanish Government, not altogether satisfied with the 16,000-ton ships building at Ferrol, intends to order some larger vessels to be built in this country; Portugal is considering a program of three 20,000 or 22,000-ton ships, and in this our own builders should stand more than equal chance with those of foreign countries. China is another nation that may enter the *Dreadnought* lists, with outside assistance, during the year; and, finally, 1912, may see an order placed for a fourth Brazilian ship, the *Riachuelo*, which has been talked of for a long time. Altogether, therefore, the outlook for the British shipbuilding industry for the next two or three years is far from discouraging.—*Naval and Military Record.*

PROGRAM FOR 1912.—The program for 1912 has not yet been published. There is, however, no indication that England's two-to-one policy will not be sustained; this will involve the laying down of at least five large armored ships, several scout cruisers, and a suitable number of destroyers and submarines.

The total naval estimates for 1911-12 amount to $216,036,101, as compared with $197,597,906 for the preceding year; while for 1909-10 the amount was $170,361,950.

The shipbuilding program authorized for 1911-12 provides for the following new construction: Five large armored ships, three protected cruisers, one unarmored cruiser, 20 destroyers, six submarines, two river gunboats, one depot ship for destroyers, and a hospital ship. An increase of 3000 in the personnel for manning the fleet is also provided.

During the year there were completed the battleships *Neptune*, *Hercules*, *Colossus*, *Orion*, and *Monarch*, as well as the armored cruisers *Indefatigable* and *Lion*. Of these the *Orion*, of 22,500 tons displacement, 21 knots speed, and the *Lion*, of about 26,350 tons displacement, 29 knots speed, are the first vessels to be completed by any navy carrying modern 13.5-inch guns and, therefore, mark a new step in the development of the all-big-gun type of ship.

The four battleships which were laid down this year, authorized in 1910, have been given the names of *Ajax*, *Audacious*, *Centurion*, and *King George V*. They will have a displacement of about 24,000 tons.

An armored cruiser, to be called *Queen Mary*, authorized at the same time, which was also laid down this year, will have, according to the newspapers, a displacement of 26,850 tons.

The displacement of the 20 destroyers for which contracts have recently been awarded is reported to be of about 920 tons. Press reports state that some of these will use internal combustion engines in connection with turbines.

The E class of submarines at present under construction are reported as having a submerged displacement of about 800 tons, and a new class of still greater displacement is said to be contemplated.—*Army and Navy Register*.

H. M. S. "ORION" COMMISSIONED.—The battleship *Orion*, the first ship completed with 13.5-inch guns, was commissioned recently at Portsmouth. This event had been delayed a few days owing to the accident in the dynamo room, regarding which inquiry will be made when those injured have completely recovered. In view of the fact that the *Orion* is the largest and most powerful ship to be commissioned, remarks the *Times*, and as she has been completed in a remarkably short time without resorting to extraordinary hours of labor, it is interesting to note the chronological course of events. The first keel plate was laid at Portsmouth dockyard on November 29, 1909, and the vessel was launched on August 20, 1910. Part of the armor was then fitted in position on the hull, and the vessel was put in one of the docks at Portsmouth yard and the fitting of the armor completed by June, 1911. The guns and mountings, which were constructed by Messrs. Vickers, Ltd., were fitted on board between April and June of last year. The Wallsend Slipway and Engineering Co., Ltd., received the contract for the propelling machinery, on December 3, 1909, and the whole of the work was completed in their works by November 29, 1910. As the engines were of 29,000 shaft horse-power, this is a highly creditable performance. The machinery was delivered at the dockyard on December 1, 1910, and completed on board and tried alongside the wharf on August 25, 1911.

Details of Steam Trials.—The official steam trials began on September 11 and concluded on September 18. On a 24-hours' trial at cruising speed the power developed was 18,966 shaft horse-power, with a coal consumption of 1.8-pound per shaft horse-power per hour, and the speed of the ship was 19.5 knots, while on the eight-hours' full-power trial the turbines developed 29,108 shaft horse-power, the fuel consumption was equivalent to 1.6-pound of coal per shaft horse-power per hour, and the speed of the ship 21.02 knots. The machinery acceptance trial was run on November 25 last, and the ship was ready for commission on December 29 last. When it is remembered that the ship is 545 feet long between perpendiculars, 88 feet 6-inch beam, and of 22,500 tons displacement at 27 feet 6-inch draft, it will be accepted that the completion in exactly two years from the laying of the keel establishes the efficiency of the dockyard alike

in its equipment and in the organization, for which Sir James Marshall, the Director of Dockyards, is responsible.

H. M. S. "LION."—The *Lion* was built at Devonport, and throughout her history the greatest secrecy has been maintained concerning her. It is understood, however, that her displacement is in the neighborhood of 26,350 tons, her overall length 680 feet, and her beam 88 feet 6 inches. She carries eight 13.5-inch guns and sixteen 4-inch guns. Reports concerning her speed are that it is expected to reach 33½ knots, and her turbines are stated to be of 70,000 horse-power.

In former issues we have given reports of this vessel as they were then current. The greatest divergence in any one case has been in the length. It is not even now known to the outside public what the exact length is, but probably 680 feet is not far from the truth. The beam, we believe to be correctly stated above, and the displacement given is probably not far from the truth.

In the early part of 1910 we endeavored to give in a drawing a forecast of this fine vessel. When this was prepared it was reported that there were only to be two funnels. According to our calculations it would have been impossible satisfactorily to dispose of the products of combustion with only two funnels of such a size that they could be conveniently mounted. We therefore gave the vessel four funnels. It will be observed that actually there are only three funnels, but that that in the center is of very large size, probably as great in area as two ordinary funnels. Moreover, the positions are such that the convenient arrangement of boilers possible with four funnels, to which we drew attention when referring to our picture, has no doubt been taken advantage of.

The substitution of 13.5-inch for 12-inch guns has already been remarked upon.—*Engineering.*

THE "LION."—The British battle-cruiser *Lion* had her eight-hour full-power trial, in the English Channel, on January 8. The contract called for development of the designed horse-power, rather than for a given speed on this trial. The vessel's turbines developed the required horse-power, with coal only, though the weather was so bad that the *Lion* did not return to Devonport till the morning of January 9.

The *Lion* will be the flagship of the first cruiser squadron, commanded by Read-Admiral Lewis Bayly. She was laid down at Devonport, November 29, 1909, launched on August 8, 1910, and completed in November, 1911. She is fitted with Parsons' turbines and forty-two Yarrow water-tube boilers. The length of the vessel is 660 feet; beam, 88.5 feet; displacement, 26,360 tons; designed horse-power, 70,000; designed speed, 28 knots, though it is reported that she made over 29 knots on her trials. Her main armament is eight 13.5-inch guns, mounted on the center-line and so arranged that all can fire on either broadside. She has sixteen 4-inch guns, and three 21-inch submerged torpedo-tubes. The armor extends from the upper deck to about 7 feet below the water-line.

The development of the British armored cruiser has been rapid in recent years. The *Invincible* class (*Invincible*, *Inflexible*, and *Indomitable*), laid down in 1906, were 560 feet long, 78.5 feet beam with a displacement of 17,250 tons. Then came the *Indefatigable*, laid down in 1909 and completed in 1911, 578 feet in length, 79.5 feet beam, with a displacement of 19,200 tons. This was followed by the *Lion* and the *Princess Royal*, the latter of which was laid down in April, 1910, and is to be completed this year.—*The Navy.*

NEW TYPE OF SUBMERSIBLE BOAT FOR THE BRITISH NAVY.—The Admiralty have placed an order with the Scotts' Shipbuilding and Engineering Co., Limited, Greenock, for the building of a submersible boat of the *Laurenti* type, as constructed by the Fiat San Giorgio Co., of Spezia. The Admiralty in ordering a vessel of the Italian type, the license for constructing which in this country has been acquired by Scotts Company, again prove

their desire to acquire experience of all forms of munitions of war. A feature of the *Laurenti* design is the construction of an outer hull to give the highest propulsive efficiency and reserve buoyancy on the surface, with the minimum of draft, and an inner hull to minimize the internal cubic capacity while ensuring satisfactory conditions when submerged. The double skin, which is braced with stays to ensure the maximum of structural strength, is confined largely to the central part, and the space between the shells up to the water-line on surface displacement is utilized to form water-ballast tanks for submergence. Kingston valves are fitted at the turn of the bilge on each side for the flooding of the compartments, and the structure is made sufficiently strong to enable the water to be pumped out without danger of collapse due to the pressure of the sea water on the outer skin; but compressed air can be, and is normally, used for expelling the water when the boat is to return to the surface. Over the central part of the ship there is a double decking, with lattice bracing, and valves are fitted on each side above the water-line, through which water automatically enters and leaves respectively for the submergence or emergence of the vessel, which is effected on an even keel. This double decking extends practically from bow to stern. Vertical bulkheads divide the interior into several compartments. The new British submersible boat will be of the twin-screw type, with twin six-cylinder Fiat engines in one engine-room, and electric motors, the latter for propelling the boat when submerged. The torpedo-tubes will be forward, under the bow, and the storage-tubes above. Italy, Sweden, Denmark, and the United States have had submersible boats of this design. The Swedish boat is the more notable, as she made a voyage from Spezia to Stockholm without escort. She is 139.4 feet long, 14 feet beam, and 8.2 feet draft, and the voyage was made in stages respectively to Carthagena, Gibraltar, Lisbon, Oporto, Vigo, Ferrol, Brest, Portsmouth, Ymuiden, Kiel, and Stockholm, the longest non-stop run—from Spezia to Carthagena—being 790 sea miles. It is appropriate that the Scotts' Company should be the first of the Clyde firms to build a British Navy submersible boat, since they were the first on the northern river to construct a battleship of the *Dreadnought* type, and have a century-old connection with the Admiralty. They are to be commended for their enterprise in entering upon a new industry.

The "surveying trawler" *Daisy*, which is about to be taken over by the Admiralty from the John Duthie Torry Shipbuilding Co., is the first vessel of the type to be built for the navy. The *Daisy* is in reality a mine-sweeper of some 600 tons displacement.

TOWN CRUISERS.—*Completion of the Group.*—H. M. S. *Yarmouth*, which is on trials on the Clyde, is the last of the four British cruisers of the *Town* class which were ordered under the 1909-10 program. The other three are now in commission. The *Yarmouth* was built by the London and Glasgow Shipbuilding Co., Govan; the *Falmouth*, which is attached to the second battle squadron of the home fleet, by Messrs. Wm. Beardmore & Co., Dalmuir; the *Dartmouth*, now at Devonport with defects, by Messrs. Vickers, Sons & Maxim, Barrow-in-Furness; and the *Weymouth*, which has just relieved the *Doris* in the Atlantic fleet, by Messrs. Armstrong, Whitworth & Co., Elswick. The Dalmuir and Barrow vessels have turbine machinery by their builders, the Elswick ship was engined by the Parsons Co.' and the *Yarmouth* has been supplied by Messrs. John Brown & Co., Clydebank, with Brown-Curtis turbines.

The vessels are "improved *Bristols*," being of greater displacement and having more powerful armament. With a length of 450 feet on the water-line and a beam of 48½ feet, they displace 5250 tons at 15½ feet draft. Compared with the *Bristols*, the freeboard has been increased, especially forward, and the increased stability resulting from the greater width enables them to carry a comparatively heavy armament of eight 6-inch guns and four 3-pounders. The 6-inch guns are mounted on the latest type of

carriage, which enables the centres to be carried out quite close to the ship's side, thus securing almost end-on fire for the broadside guns. Five out of the eight guns can be fired sumultaneously on either broadside, and three ahead and astern. The vessels are fitted with two torpedo-tubes for the latest 21-inch torpedoes.

The *Falmouth* was the first of the three vessels to be completed and to be commissioned. On trial she attained a speed of 27.1 knots. Her machinery is of the Parsons' turbine type, with four ahead and four astern turbines—one ahead and one astern on each of four shafts, and the turbines working in series on two shafts on each side of the center-line of the vessel. Cruising turbines were dispensed with, the high pressure ahead turbine being extended at the high pressure end, so as to increase the range of expansion when running at less than full power, with a by-pass to admit steam at an intermediate stage for the higher speeds.

The *Dartmouth* attained a speed of 25.9 knots while developing 23,500 shaft horse-power. It was anticipated, in consequence of the increased displacement over the *Bristol* class, that the speed would be somewhat less for a given expenditure of power, but a comparison of the trial results of the *Dartmouth* with those of the *Gloucester* of the earlier class show a great similarity of performance. The *Gloucester* obtained a speed of 23.45 knots, with 13,970 shaft horse-power, and the *Dartmouth* 23.49 knots, with 14,290 shaft horse-power. The *Gloucester* at 25.08 knots expended 18,980 shaft horse-power, whilst the *Dartmouth* at 24.97 knots required 18,840 shaft horse-power.

The trials of the *Weymouth* were also most satisfactory. These three vessels have machinery similar in type. In the *Yarmouth*, however, turbines of the Brown-Curtis type are fitted by Messrs. John Brown & Co., Clydebank. They are similar in design to those so successfully adopted in the *Bristol*, which was built at Clydebank. With this type of turbine two shafts only are required, and a lower rate of revolutions is maintained than with the Parsons, thus enabling a higher propeller efficiency to be obtained.—*Naval and Military Record.*

H. M. S. "CHATHAM."—The launch of the new cruiser *Chatham* recently was naturally an event of importance for the eastern yard, at which no large vessel has been built since the *Shannon* was put afloat in 1906. For reasons which are well known the only new vessels whose construction has been allotted to *Chatham* since that year have been submarines, but that the yard is quite able to build larger ships expeditiously is shown by the case of the *Chatham*. From the particulars given of the new cruiser it is evident that her design shows an advance over that of the *Dartmouth*, but not so great as was that of the last-named over the *Bristol*. Whereas the displacement of the *Bristol* was 4800, and of the *Dartmouth* 5250 tons, that of the *Chatham* has gone up to 5400 tons. There will also be no change in the armament from that in the *Dartmouth*—viz., eight guns of 6-inch caliber. On the other hand, there is to be noted a great increase in length and also in horse-power, which rather indicates that the speed of the *Chatham*, which has not been stated officially, will be higher than that of the predecessors, of which the *Bristol* was designed for 25 knots and the *Dartmouth* for 24¾ knots. This would not be surprising, considering that some very fast small cruisers have recently been built abroad.—*Army and Navy Gazette.*

The unarmored cruiser *Amphion*, which was launched at Pembroke dockyard, is a third-class cruiser of the improved *Boadicea* type. Like her sister ship, the *Active*, she belongs to the 1910-11 Navy Estimates; but the two ships are not being built simultaneously. The *Amphion* was laid down on March 15 last, the day following the launch of the *Active*, which has passed through her trials, and is now preparing for commission; the *Amphion* will, it is expected, be ready for the pennant in September, 1912, ships of this class taking rather less than 18 months to build, from laying

down to completion. The *Amphion* is the sixth of the modern third-class unarmored cruisers, and the estimates for the current year provide for the construction of a seventh, which was laid down at Pembroke on November 15. The duty of these ships is to serve, like the older "scouts," as stiffeners and supports to the destroyer flotillas, to which they are attached.

The first keel-plates of a new unarmored cruiser of the *Boadicea* class have been laid down at Pembroke dockyard. She will be the seventh vessel of the type, and will differ from the earlier ships as regards her armament and the type of her turbine machinery.—*Page's Weekly.*

H. M. S. *Archer*, one of the five special destroyers building for the British Admiralty by Messrs. Yarrow, of Glasgow, has had a very successful official full-speed trial on the Skelmorlie deep water measured mile at the mouth of the Clyde. Although the weather was exceptionally bad, a mean speed of 30.3 knots was attained during a continuous run of eight hours, thus exceeding the contract speed of 28 knots by 2.3 knots.

Throughout the trial the whole of the machinery worked perfectly. The special feature of interest was the boiler installation, the boilers being fitted with Yarrow's patent system of superheating; the average superheat during the trial was 94 degrees Fahrenheit, from which a very appreciable gain in economy was obtained.

BATTLESHIPS—ENGLAND AND GERMANY.—The following table shows the number of battleships maintained in full commission by Great Britain and Germany each year from 1904 onwards:

	Great Britain			Germany
	Home.	Foreign.	Total.	Home (total).
1904	16	17	33	8
1905	20	13	33	12
1906	24	8	32	15
1907	26	6	32	16
1908	26	6	32	16
1909	22	6	28	16
1910	22	6	28	16
1911	22	6	28	17

In seven years, therefore, the fully commissioned battle fleets of Great Britain have been reduced by five units, or 15 per cent, while that of Germany has been increased by nine units, or 112.5 per cent.

SPEED OF CONSTRUCTION OF BATTLESHIPS.—The battleship *Centurion*, launched at Devonport on November 18, is the twenty-eighth all-big-gun ship launched this year. The following table of launches shows the rate at which the building of *Dreadnoughts* is spreading.

Power for whom launched.	Year of launch and number					
	1906.	1907.	1908.	1909.	1910.	1911.
Great Britain	1	6	2	3	4	8
Germany	..	..	4	4	2	4
United States	..	..	3	2	1	2
Brazil	..	..	1	1	..	..
Japan	..	..	..	..	1	1
Italy	..	..	..	..	1	3
Russia	..	..	..	..	..	4
France	..	..	..	..	..	2
Argentine	..	..	..	..	..	2
Austria	..	..	..	..	..	1
Spain	..	..	..	..	..	1
Totals	1	6	10	10	9	28

—*Journal of the Royal Artillery.*

BATTLESHIP FLOATING DOCK.—An immense floating dock for the British Admiralty was successfully launched on Thursday, January 4, from the Wallsend shipyard of Messrs. Swan, Hunter & Wigham Richardson, Ltd. Some idea may be gained of its size when it is known that the ground area it covers is no less than two and a quarter acres, while the total height of the side walls is 66 feet. This is one of three docks that Messrs. Swan, Hunter & Wigham Richardson, Ltd., are constructing at present for the British Admiralty, for whom they also built a battleship dock several years ago. This last named was designed for accommodating vessels displacing 17,000 tons, and is stationed at Bermuda. The dock that has just been launched has nearly twice that lifting capacity, namely, 33,000 tons. In addition to the docks built for the British Admiralty, others have been constructed at the Wallsend shipyard for various other governments. The way in which these immense structures can be towed to distant parts is most remarkable. The British Admiralty dock for Bermuda was towed nearly 4000 miles to its destination. The floating dock for the Natal Government was towed over 8000 miles to Durban, and a 7000-ton dock was safely delivered a year or two ago at Calao, the port of Lima, in Peru, the distance from the Wallsend shipyard being about 11,000 miles. Other docks built by the same firm have been towed to various European ports, and also to more distant ones, such as Para in Brazil, Port of Spain in the Island of Trinidad, Egypt, and the west coast of Africa.

The dock that has just been launched is double-sided, and in designing it the builders have been closely associated with Messrs. Clark & Standfield, of Westminster. At the bow end of the dock there is a pair of pivoted flying gangways, to give access from one wall of the dock to the other. In the walls of the dock is living accommodation for a number of officers and men. A complete telephone system is also installed to give communication between engine and boiler rooms and different parts of the dock. There are eight steam boilers, which have been constructed at the Neptune Engine Works of the builders. The pumps have been supplied by Messrs. Gwynnes, Ltd. There is also a very complete outfit of steam and hand capstans placed on the walls of the dock to warp vessels into position. The dock is lit by electricity throughout and on the walls are two electric travelling cranes. In order to facilitate rapid repairs, a commodious workshop is provided in one of the walls with an equipment of machine tools and all necessary plant and appliances. Preservative bituminous enamel and solution by Messrs. W. Briggs & Sons, Ltd., of Dundee, has been applied to the dock externally and internally.

Altogether the dock will represent the most complete and efficient means of overhauling and repairing the largest type of modern battleship yet designed or constructed. It is a worthy product of the famous Wallsend shipyard and a fitting addition to the greatest navy the world has known. —*The Marine Engineer.*

FAST BUILDING.—The trials of H. M. S. *Monarch*, the first of the *Contingent* battleships, have commenced, and the vessel, which has just left Elswick, has proceeded to Devonport to be dry docked prior to the full-power trials. Sir W. G. Armstrong, Whitworth & Co. have created a record in battleship construction in this case, for the vessel was only ordered in April, 1910, and, in spite of the delay occasioned by the shipbuilders' strike last year, was launched in exactly twelve months and completed for trials in the following six. With the Brazilian and Chilian battleships also in hand, Elswick has over 80,000 tons of battleship work under construction at the same time.—*Engineering.*

COALING AT GIBRALTAR.—Another coaling record has just been achieved, and by the same ship—the *Triumph*. She has made a record for the British Navy, and the Mediterranean fleet in particular have good reason to be proud of her. In one morning she took in 640 tons in 1 hour 15 minutes,

the average working out at 512 tons per hour! This is splendid, and too much praise cannot be given for the wonderful organization and the extraordinary energy that must have been forthcoming to produce such a result.—*Naval and Military Record.*

SPEED IN BATTLE-CRUISERS.—It is a matter for extreme gratification that our latest battle-cruisers are likely to obtain a speed of close on 30 knots to the hour; although the contractor speed for the *Lion* group was 28 knots, which in itself was a considerable advance on the *Invincibles* which were designed for 25 knots and only attained 28.6 knots as an "extra." Now the *Lions* are designed for 28, and will probably reach and even exceed 30 knots on trial. The two new battle-cruisers provided by the Colonies and named, respectively, the *Australia* and *New Zealand*, were designed for 26 and will steam over 29 knots. The *Queen Mary* and her sister, although over 1000 tons larger than the *Lion* group, are designed to steam 28 knots only, but will probably exceed 30 at their best. The gratification regarding these speeds comes in when we consider that the ships named will have the heels of nearly every class of destroyer in our own and, what is much more to the point, also in foreign navies. The Germans have 33-knot sea-going destroyers, but this speed could only be attained when the surface of the sea is as smooth as a mirror, and even at such times the necessary current of air in the stokehold to make the boilers do their best, is not forthcoming except such light airs as come from that quarter of the world towards which the vessel is wending her way. The fast battle-cruiser, therefore, will be able to overtake a destroyer or escape from a group of them with comparative ease, in nine cases out of ten. Speed has hitherto been on the side of the destroyers, but this advantage will now be lost unless rapid developments take place in increasing the speed of these torpedo craft.—*United Service Gazette.*

DEFECTIVE "DREADNOUGHTS."—Lord C. Beresford asked the First Lord of the Admiralty, on November 30, whether he was aware that some modification was necessary in the control positions of His Majesty's ships *Orion, Conqueror, Thunderer, Lion, Princess Royal, Colossus,* and *Hercules;* whether he knew that the spotter was stationed abaft the fore funnel and almost over it, and was liable to be suffocated; whether the heat from the funnel often produced a temperature of 220 degrees at the locality where the spotter was stationed; and whether any proposals would be made to remedy this state of affairs.

Mr. Churchill replied: Inconvenience has been experienced in the control positions in the ships named in the question, and modifications are now under consideration.—*United Service Gazette.*

An explosion occurred on the morning of December 12 on board His Majesty's ship *Orion,* at Portsmouth, and the following were injured: Commander Herbert N. Garnett, R. N., Admiralty; Lieutenant (T.) Brian Egerton, R. N., His Majesty's ship *Orion;* Engineer-Lieutenant Henry S. Brockman, R. N., His Majesty's ship *Orion;* Mr. Charles Davidge, gunner (T.), His Majesty's ship *Orion;* Mr. Patrick P. Coleman, boatswain (T.), Admiralty; Albert Hudson, stoker, O. N., D. K. 4817, His Majesty's ship *Orion;* Mr. James Pringle, electrical engineer, Admiralty; Mr. Albert Franklin, assistant electrical engineer; Mr. William Green, inspector of electrical fitters; Thomas Metcalfe, chargeman of electrical fitters, No. 6772; Henry Driver, electrical fitter, No. 8684; William Richards, electrical fitter, No. 8677; John Willis, electrical fitter, No. 6659; William Rycroft, electrical fitter's apprentice, No. 6660; William Ward, electrical fitter's apprentice, No. 8676; Charles Irish, skilled laborer, No. 8695; George Marder, laborer, No. 794; Alfred Goldfinch, laborer, No. 722. All the injured are doing as well as can be expected. Later information added the names of Lieutenants Grant and Parker to the injured. Lieutenant Egerton is a son of Vice-Admiral Sir George Egerton, until recently the Second Sea Lord.

The battleship *Orion*, which is completing for commission at Portsmouth, where she has been built, has already passed her speed, gunnery, and torpedo tests very satisfactorily, and lies in No. 15 dock. A number of experts from London and Portsmouth were assembled on board to see the electrical machinery under full working conditions, and they were accompanied by some of the executive officers attached to the ship. All of them were watching the working of the second dynamo, the first having worked very satisfactorily; the second appeared to be acting very smoothly, with its principal bearings running in an oil-bath, when there was a sudden, sharp explosion, the cover of an oil-tank or bath was blown away, and the compartment was filled with flames.

It is supposed that the dynamo in some way got overheated, while another suggestion is that an electric spark was emitted and ignited inflammable vapor from the oil, but in the absence of any official statement the exact cause is difficult to ascertain. From all parts of the naval establishment medical aid was rendered. Staff Surgeon Nimmo, of the Royal yacht *Alexandra*, was one of the first to arrive, and then came the dockyard surgery doctors and several fleet and staff surgeons. The surgeons, after attending first to the more serious cases, devoted their zeal to those whose injuries were not so severe. After temporary dressing on the ship the men were conveyed to the dockyard surgery. The condition of 14 of the injured necessitated their removal to Haslar Hospital.—*United Service Gazette.*

Orion (battleship, Capt. A. W. Craig), flagship of Rear-Admiral H. G. Hing-Hall, C. V. O., C. B., D. S. O., Second Division, Home Fleet.—The damage sustained by the vessel coming in contact with the battleship *Revenge*, when the latter broke from her moorings in Portsmouth harbor, was not considered sufficiently serious to warrant her detention for docking and repairs. After the present cruise of the division for exercises off the coast of Spain, the vessel, it is understood, will be despatched to Devonport for repairs to be effected.—*Army and Navy Gazette.*

LOSS OF BRITISH "A-3."—The collision of the British submarine *A-3* with the British gunboat *Hazard*, at the entrance to Spithead, on February 2, resulted in the death of four officers and ten men of the *A-3* and the total loss of the vessel. Salvagers have raised what is left of the submarine, in order to recover the bodies and for the purpose of investigation from naval construction points of view.

The collison occurred as the *A-3* was engaged in practice with a flotilla of sister ships. The *Hazard*, passing over the water where the submarine was just coming to the surface, struck her from above and on her side, causing her to sink.

The *A-3* belonged to the earlier type of British submarines, these vessels having been used during the past year for harbor and coast defence maneuvers.

Although no detailed information as to the particular case of the *A-3* has been given out by the British Admiralty, this, like similar accidents to other submarines, in both the British and French Navies, was undoubtedly simply an accident.—*The Navy.*

THE ADMIRALTY WAR STAFF.—On January 1, 1912, the First Lord (Winston Churchill) of the British Admiralty created the Naval War Staff, and, in a memorandum, explained its character and duties, the reasons for the same, and that the additional expense involved is to be compensated for by abolition of four of the Admiralty yachts.

The appointments made all date from January 8, and were as follows: Chief of the Naval War Staff, Read-Admiral E. C. T. Troubridge; Director of Operations, Captain G. A. Ballard; Director of Intelligence, Captain Thomas Jackson.

A new office, that of an additional Civil Lord, was also created to look after Admiralty contracts, to be the buyer and business manager of the Admiralty, and to furnish the Third and Fourth Sea Lords with all that they may require in order to build, arm, equip, and supply the fleet.

Additional Civil Lord, Sir Francis Hopwood.

The title of Private Secretary to the First Lord is changed to Naval Secretary, and Rear-Admiral David Beatty had been appointed to this post.

These four sea lords both advise and exercise executive power. The aids in this country can advise only.

In the United States the Naval War Staff is known as the General Board. The latter has more members than the former, but its duties correspond.

The diagram above is to show graphically the similarity of the present organization of the British Admiralty, and our own Navy Department. The words in parentheses indicate the titles of American positions similar to the English positions.

The duties of the members of the Admiralty and Staff are laid down as follows in the memorandum:

Each of the Sea Lords on the Board of Admiralty has a special sphere of superintendence assigned to him by the First Lord in pursuance of the Order in Council. The First Sea Lord is charged with preparations for war and the distribution of the fleet. The Second Sea Lord, who is to be kept in close relation to the First Sea Lord, mans the fleet and trains the men. The Third Sea Lord directs the military construction of the fleet; and the Fourth Sea Lord is responsible for furnishing it with adequate and suitable stores and ammunition. All these heads of large departments will have occasion, in the discharge of their respective duties, to recur to the War Staff or its various branches for general information or for working out special inquiries.

Since, however, under the distribution of Admiralty business on the Board, the First Sea Lord occupies for certain purposes, especially the daily distribution of the fleet, on which the safety of the country depends, the position of a Commander-in-Chief of the Navy, with the First Lord immediately over him as the delegate of the crown in exercising supreme executive power, it follows that the War Staff must work at all times directly under the First Sea Lord. His position is different in important respects from that of the senior member of the Army Council as constituted. The First Sea Lord is an executive officer in active control of daily fleet movements who requires, like a general in the field, to have at his disposal a chief of the staff, but who is not the chief of the staff himself.

A proper staff, whether naval or military, should comprise three main branches—namely, a branch to acquire the information on which action may be taken; a branch to deliberate on the facts so obtained in relation to the policy of the state, and to report thereupon; and thirdly, a branch to enable the final decision of superior authority to be put into actual effect. The War Staff at the Admiralty will, in pursuance of this prin-

ciple, be organized from the existing elements, in three divisions: the intelligence division, the operations division, and the mobilization division. These may be shortly described as dealing with war information, war plans, and war arrangements respectively. The divisions will be equal in status, and each will be under a director who will usually be a captain of standing. The three divisions will be combined together under a chief of the staff.

The chief of the staff will be a flag officer. He will be primarily responsible to the First Sea Lord, and will work under him as his principal assistant and agent. He will not, however, be the sole channel of communication between the First Sea Lord and the staff; and the First Lord and the First Sea Lord will whenever convenient consult the directors of the various divisions or other officers if necessary. This direction is essential to prevent that group of evils which have always arisen from the "narrow neck of the bottle" system. The chief of the War Staff will guide and coordinate the work of the staff in all its branches. He will, when desired, accompany the First Lord and the First Sea Lord to the Committee of Imperial Defence.

Although the methodical treatment of the vast number of subjects to be dealt with by the staff requires that there should be divisions and subdivisions, yet it is imperative that these should never be permitted to develop into "water-tight" compartments. It will be found that there is so much overlapping between divisions, that a constant, free, and informal intercourse between them is indispensable. To promote this, the chief of the staff will be enjoined to hold frequent meetings—to be called "staff meetings"—with the heads of three divisions, and each of the directors will be kept fully acquainted with the work of their two colleagues. Each one of the directors will be ready at any moment to act for the chief of the staff in the latter's absence from whatever cause. In times of profound peace, action has often to be taken immediately on the receipt of some telegraphic report or a request from one of the other departments of state; one of the three directors will therefore always remain within prompt call by messenger, night and day.

The functions of the War Staff will be advisory. The chief of the staff, when decision has been taken upon any proposal, will be jointly responsible with the secretary for the precise form in which the necessary orders to the fleet are issued, but the staff will possess no executive authority. It will discharge no administrative duties. Its responsibilities will end with the tendering of advice and with the accuracy of the facts on which that advice is based.

Decision as to accepting or rejecting the advice of the staff wholly or in part rests with the First Sea Lord, who, in the name of the Board of Admiralty, discharges the duties assigned to him by the Minister. In the absence of the First Sea Lord for any cause the Second Sea Lord would act for him.

The selection of officers to be appointed to this War Staff is to be made in this wise: The president of the college will be entrusted with this important duty, and, in order that it may be carried out to the best effect, he will at all times be in close touch and association with the chief of the staff. In course of time the appointment will be held by a flag officer who has been a staff officer himself. Candidates for the staff will be selected from volunteers among lieutenants of suitable seniority as well as officers of other branches throughout the service, irrespective of their previous qualifications as specialist officers or otherwise, and those who pass the necessary examinations at the end of or during the war college course will be eligible to receive appointments either at the Admiralty or on the staff of flag officers afloat as they fall vacant. In all cases, however, regular periods of sea-going executive duty will alternate with the other duties of staff officers of all ranks, in order that they may be kept up to the necessary standard as practical sea officers. All appointments on sea-going staffs will in the course of time be filled by these officers, and form the proper avenue to eventual employment in the highest staff position at the Admiralty.

THE INITIATION OF A NAVAL WAR STAFF.—Perhaps the first question which the ordinary intelligent man will ask with regard to the Admiralty memorandum on a Naval War Staff is—What is the Naval War Staff to do? What is its precise function. Its function will be to make a special study of the operational side of war in contradistinction from its technical and material side. One of the great defects of the navy at present is the lack of thought and of continuity of thought in tactics, strategy and war operations. An admiral is appointed to the command of the home fleet. During his first year he is absorbed in administrative work, and it is probably not till his second year that he begins to pay attention to tactical and strategical problems. But he has no body of doctrine to assist him; nor has he any assistants specially trained in such work. He probably reflects what his predecessor has already done. Then comes his successor and does it all over again. There is the same lack of continuity with regard to the study of war operations, and there are no systematized methods of war direction. The machinery of a staff organization has been framed in order to supply this deficiency, but it must not be considered as anything more than a framework. The real problem is the collection and training of a body of staff officers. Still the appointment of a chief of staff responsible for the study of war problems and unhampered by administrative work will tend towards a coordination of thought and effort. But the gunnery and torpedo schools were not created in a day, and it will take some years to create a true staff, though its function is clear enough. It is really an expression of the growing complexity of modern warfare and modern industry. In the last forty years, the enormous strides made in things technical and material have absorbed a large part of the mental energy of the service, with the inevitable result that while great attention has been paid to the mechanism and construction of guns and ships, the science of their actual application—for this knowledge is big enough to make an entirely separate science—has been largely neglected. The navy and army differ from every other big business in that they only occasionally perform their business. It is the work of a staff to study just exactly what that business will be, and to ensure its intelligent direction in time of war.

The war college has certainly done something in this direction, and its work must not be depreciated. It is in fact a very essential part of a staff system. But its work is greatly discounted by the shortness of the course (only three months) and the mature age of those who attend it. A number of the officers (most of them post captains) who go there simply look upon it as a full-pay oasis in the arid plain of half pay. This reacts on the spirit of the place, for one dare hardly be intelligent for fear of being called a dreamer by the unintelligent "bloc." It is almost impossible for those outside the service to appreciate how the study of war and of war direction has been neglected in the past. Up to 1900 the word tactics was attached to the performance of certain quadrille movements which had no earthly relationship to the realities of battle. A good deal has been done to improve matters, but the navy lacks original thinkers to sift its work and embody it in clear and simple principles. Or if we have such men, they lack time and leisure. The name and mechanism of a War Staff are only the first step on the journey. We have not yet got a real staff, and the first duty of the staff, when we have it, will be to evolve itself by a process of gradual evolution. We must endeavor to create a certain type of mind—keenly critical and outspoken, but honest and loyal. But the genius of the British officer lies not in criticizing and investigating but in action—in doing things and not in thinking. The naval mind is severely practical, and the practical mind is often an unresilient mind which not only has no desire to investigate things, but is perfectly incompetent to perform such work. Again, much of our best talent has been switched on to technical lines, and, working constantly amongst things material, it seems to find difficulty in moving easily in immaterial spheres of abstract thought and expression. The first

business then of the War Staff will be to switch a certain proportion of the younger talent on to the subjects of war, tactics and strategy.

The first paragraph of the memorandum where a comparison is drawn between war on sea and war on land is weak because it confuses the routine work of a staff with its higher functions. Transport problems are of course radically different on land and sea; but transport problems are largely matters of routine calculation. It is true that these matters do not require so much calculation in the navy, for every ship is self-contained, and transport by water is simpler than transport by land. But so far as higher problems such as commerce-defence and invasion are concerned, the navy has just as much to do as the army. The naval staff officer certainly does not need to worry his head over long march tables, but on the other hand the technical problems he has to solve are more numerous and more varied. Looking at the organization of the staff, the principal relationship to consider is that of the chief of staff to the First Sea Lord. The former is to be directly subordinate to the latter, and his duties will be advisory and not executive. This is as it should be; but it must be clearly understood by the First Sea Lord that the chief of staff is a real and important entity, and not a mere figurehead to supply arguments for proconceived ideas. The relationship of the chief of the staff to the president of the war college is to be one "of close touch and association." This is somewhat nebulous, and is made still more so by the fact that the present holder of the war college appointment is a vice-admiral, while the chief of the staff is a rear-admiral. The memorandum makes it clear that staff officers will be a branch of specialists and will be on the same footing as other specialists. A great number of naval officers look with suspicion on the word "staff," because they imagine it will be used as a kind of "open sesame" to command.

A careful distinction must be made at the very outset between "staff" qualities and "command" qualities. Staff qualities are intellectual, and include a critical scientific mind and a circumferential view of things. Command qualities are largely moral and include decision, common sense, energy and nerve. These latter qualities will just as often be found outside the staff as inside it, and staff officers must understand that their selection and training will give them no more claim to command or to promotion than any other form of specialism. In fact there is no great danger of their thinking it will, for presumably on attaining the rank of captain a staff officer would be merged once more in the line of general work. Again, staff officers must not be divorced from the sea. They must not be left too long ashore—a defect conspicuously evident in the case of many gunnery and torpedo specialists. The fourteenth paragraph of the memorandum discusses the selection and training of staff officers, and this is the crux of the whole question. What is wanted is a critical investigatory type of mind, and in the officers selected to be the first instructors this must be combined with real enthusiasm and interest in instructional work. The memorandum talks of "passing the necessary examinations at the war college," and here there seems a danger of the examination-fetish creeping into the system. An examination is at once the easiest and most fallacious method of testing ability. There should be as few examinations as possible. Problems should be set for investigation, principles explained and criticisms encouraged. Merit should be estimated by an officer's general work and by essay writing, not by examinations which are unsuitable for a staff training whose object is to equip with faculties, not to load with facts.

What is wanted in our staff officers is the critical mind, and the men whom the average captain, hating criticism, would be the last to recommend are possibly the very ones who ought to be selected. Officers who cannot think and write will never be able to initiate a staff. The First Lord has supplied the navy with a good staff house. It is now the business of the navy to fill it with a good staff type.—*Naval and Military Record.*

A CRITICISM.—A week's reflection on the Naval War Staff has shown that it meets with much approval. In summary, all that has been done is to graft on to the existing intelligence and mobilization departments another for working out war plans, and to place all three branches under the orders of a rear-admiral. The sheme leaves the Board of Admiralty supreme, with, however, this important difference—that a well-equipped War Staff will strengthen the hands of a strong Sea Lord and will probably dominate a weak Sea Lord. That the War Staff will compose all differences between naval officers on questions of strategy and tactics is impossible, and it would be bad for progressive naval opinion if it were possible. The scheme has many good points, but it is quite safe to say that at present the majority of naval officers have not come to any definite conclusion upon it. A great deal will depend upon the forthcoming decisions by the First Lord as to the distribution of business, showing exactly to what extent naval administration is likely to be improved by the two new elements at the Admiralty—the War Staff and the new Civil Lord.—*Naval and Military Record.*

A DANGER IN THE NAVAL WAR STAFF SCHEME.—Under the system provided for selection of members of the Naval War Staff, *only* those who have been fortunate enough to have had a special course of training at the War College will know and feel that they can ever receive an appointment at the Admiralty, or on the staff of a commander-in-chief, or to a higher staff position. This follows because, judging by all appointments, service at the Admiralty is always required before such employment afloat.

ITALY.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Dante Alighieri	19,000	Gov't Yard, Castellamare.	Launched Aug. 20, 1910.
Cavour.	22,000	" " Spezia.	" Aug. 10, 1911.
Giulio Cesare	22,000	Ansaldo-Armstrong.	" Oct. 15, 1911.
Leonardo da Vinci ...	22,000	Genoa (Odero).	" Oct. 14, 1911.
Scouts.			
Quarto.....	3,400	Venice.	" Aug. 19, 1911.
Marsala	3,400	Castellamare.	Building.
Nino Bixio.....	3,400	"	"

BUILDING PROGRAM.—The naval appropriation for 1911-12 amounts to $37,676,548.

In 1909 the Italian parliament passed a law which established the naval program for each year up to 1916. Recently parliament passed another law extending this program to include the years 1916-17 and 1917-18. A certain sum is allowed each year for new constructions and the maintenance of the fleet. The number and type of ships to be laid down each year is determined by the minister of marine; therefore, it is not possible to know what vessels are to be built until the Navy Department has made its decision after the appropriation is made. According to press reports, three new battleships are to be laid down during the present fiscal year, and plans for new ships are known to be under consideration by the Navy Department, but no official announcement has yet been made.

During 1911 there were under construction the following: Four battleships, three scout cruisers, 10 destroyers, 32 torpedo-boats, and 13 submarines.—*Army and Navy Register.*

PROGRAM FOR NEXT YEAR.—The estimates for 1912-13 amount to $41,859,030. Of this amount $11,580,000 is for the maintenance of existing vessels and for new construction now in hand or to be commenced. Since the naval appropriation law does not specify the number or type of ships

to be laid down—this being left to the discretion of the Navy Department—there is no official information at hand showing the new construction contemplated for the coming year.

In addition, however, to the four large battleships now building it is known that two were recently ordered to be built at government yards, on one of which work was begun in December, 1911, and it is reported that contracts for two more will be let in the near future.—*Army and Navy Register.*

The battleship *Conte di Cavour* has the following characteristics: Displacement, 22,700 tons; length, 551 feet; breadth, 88.5 feet; draft, 27.22 feet. There will be 12 boilers fitted for burning both coal and oil, eight to burn oil only. Four Parsons' turbines. Horse-power, 24,000; speed, 22 knots; maximum coal supply, 2500 tons. Radius of action at highest speed, 1000 miles. Radius of action at economical speed, 3000 miles. Thirteen 12-inch guns in five turrets in same fore and aft line; Nos. 1, 3 and 5 turrets to have three guns each, Nos. 2 and 4 to have two guns each and five over the three gun turrets, giving a broadside of thirteen 12-inch, a bow or stern fire of five 12-inch. Eighteen 4.8-inch 50-caliber guns in armored casemates; fourteen 3-inch; two field pieces; four automatic guns; and three under-water torpedo-tubes.

A battleship of 25,000 tons was put on the ways the last of October at Spezia.

The first of the 12 torpedo-boats ordered from the Odero shipyard of Sestri Ponente was launched October 17. It is named *O. S. 13.*

The submarine *Medusa* in October attained a speed of 14.57 knots, or 2.5 knots over her contract speed.

The captured Turkish ships, *Thetis* and *Derna*, have been placed in the Italian fleet, rechristened the *Capitaine* and the *Benghazi* respectively.

THE ITALIAN FLEET AND TRIPOLI.—The *Popolo Romano* rebukes those excited journals which cry out against the supposed inaction of the Italian fleet, and expect it to bombard Salonica, to penetrate the Dardanelles, and to destroy Constantinople. The *Popolo* says that the fleet has anxious duties, and is ready to act, officers and men being full of patriotic zeal. But this is no reason why the government should be impelled to adopt a course of action based upon perilous delusions which might lead to serious consequences. In short, the Roman journal thinks the game would not be worth the candle. It says that it is folly to believe that active operations of the Italian fleet would induce the Turkish ships to come out from their shelter, and that no glory or credit is to be gained in the open sea. It appears to have been rumored that the fleet had cut the cable between Lemnos and one of the islands, but the *Popolo* says that the question of occupying any of the islands and of blockading the entrance to the Dardanelles or the coast of Syria must be left to the government.—*The United Service Gazette.*

ARMAMENT OF "DANTE ALIGHIERI."—In the *Dante Alighieri*, the first Italian *Dreadnought* now building, there will be four triple turrets, mounted on the center-line, all on the same level, a pair of turrets being placed amidships between the fore and aft superstructures. On a displacement of 19,000 tons, the *Dante Alighieri* will carry, in addition to her turret guns, an armament of twenty 4.7-inch guns, eight of which have been mounted in four small turrets placed well forward and aft on each side, in such position as to interfere as little as possible with the big guns. The placing of these eight guns in this manner is to increase the resistance offered to torpedo attack on the beam or quarter.—*The Navy.*

JAPAN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Aki	19,800	Kure.	Under trial.
Kawachi	20,800	Yokosuka.	Launched Oct. 15, 1910.
Settsu	20,800	Kure.	" March 30, 1911.
Fuso	24,000	"	Laid down December.
Armored Cruisers.			
Kongo	27,000	Vickers.	Building.
Haruna	27,000	Kobe.	"
Kirishima	27,000	Nagasaki.	"
Hiyei	27,000	Yokosuka.	Ordered.
Protected Cruisers.			
Shikuma	5,000	Sasebo.	Launched Apr. 1, 1911.
Yahagi	5,000	Nagasaki.	" Oct. 3, 1911.
Hirado	5,000	Kobe.	" June 29, 1911.

PROGRAM FOR THIS YEAR.—The total naval estimates for the year 1911-12 amount to $42,044,329. This is an increase of $5,234,700 over the estimates for the preceding year.

The Japanese Diet has recently authorized the amalgamation of the existing shipbuilding programs or appropriations into one under the title of "expenses for maintaining naval preparations." The unexpended balance of the existing appropriations amounts to $82,892,305, to which was added a further sum of $40,947,130 for the purpose of enlarging ships already authorized but not yet commenced. The total sum available, therefore, amounts to $123,839,443, which is to be expended in six years—that is, up to and including the fiscal year 1916-17. Out of this there has been set aside for the construction of men-of-war the sum of $78,837,591.

An armored cruiser of about 27,500 tons displacement was laid down January 17, 1911, in England by Messrs. Vickers, Sons & Maxim. Three similar vessels have been ordered to be built in Japan. These vessels are reported as being designed for a speed of 29 knots and will carry either 13.5-inch or 14-inch guns. A battleship which will probably be laid down in 1912 is also included in the present building program.

During 1911 there were completed the battleship *Aki*, of 19,800 tons displacement, and the armored cruiser *Kurama*, of 14,600 tons displacement. —*Army and Navy Register.*

BUILDING PROGRAM.—Two very different reports have been received as to a new naval program which will shortly be placed before the Japanese Chamber. According to one statement a sum of £40,000,000 is to be demanded, to be spread over seven years; while the other states the sum to be £25,000,000 (in addition to £8,200,000 remaining from votes already made), to be spread over either six or ten years. The latter statement adds that the vessels it is proposed to build are three battleships, four battle-cruisers, three third-class cruisers, and a number of river gunboats and mine-layers. —*Journal of the Royal Artillery.*

FLOATING DOCK.—A Reuter's telegram from Tokio says: The new naval drydock recently launched at Nasebo Naval Yard is the largest in Japan. It has taken four years to construct, and will not be quite completed for another four months. It will lift warships up to 30,000 tons. It is 777 feet in length and 111 feet in breadth.

The Japanese Naval Department is arranging to commission shortly a squadron of ocean-going destroyers.—*Naval and Military Record.*

FINANCIAL.—There is nothing very surprising in the announcement which has been made by the Japanese Minister of Finance that owing to

monetary difficulties it is impossible at present to carry out the government's naval expansion projects. Ever since the war with Russia Japan's financial position has been growing more and more unsatisfactory, and large sums have been borrowed. At the end of 1909 the debt stood at £229,718,821, but by the end of last year more than forty-two millions had been added to this. The actual expenditure on the navy does not appear to have increased very much in recent years. In 1901 the estimates were £4,485,892, and although this had been nearly doubled by 1908, they have since shown no decided tendency to increase, as the following figures will show: 1908, £8,094,885; 1909, £7,490,000; 1910, £7,695,647; 1911, £8,803,015. It is not quite clear what is meant by "the government's naval expansion projects." This year, as is well known, no fewer than five armored ships have been laid down or ordered for the Japanese fleet—one in this country and four in Japan—and although no definite news of the progress with the latter group is available, it is certainly more than likely that they have progressed so far that they cannot be retarded for two years (the suggested period of postponement) without necessitating a recasting of the whole design. The present crisis is the issue of a long conflict between the Minister of Marine, Admiral Saito, on the one hand, and M. Yamamoto, Minister of Finance, on the other; and the admiral must certainly have found it difficult to justfy a five-ship program in one year. In all probability this ambitious program was embarked upon as the result of the wide-spread agitation of last year. If so, it is only one more proof of the wisdom of counting the cost before demanding standards or laying keel-plates.—*Naval and Military Record.*

NEXT YEAR'S PROGRAM.—The program for 1912 has not been officially announced. Press reports state that the current six-year program under which four battle-cruisers and one battleship were laid down or ordered in 1911 is to be still further augmented by several battleships during the coming year.

The appropriation for maintenance and construction of ships is a continuing appropriation laid down in the program, the allotment for the year 1912-13 being $24,144,446, as against $21,768,673 for the year 1911-12. This clearly indicates an increase in the amount of construction in hand, aside from any new program that may be introduced.—*Army and Navy Register.*

RUSSIA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Sevastopol	23,000	St. Petersburg (Baltic Wks.).	Launched June 29, 1911.
Petropavlovsk	23,000	" "	" Sept. 9, 1911.
Poltava	23,000	" (Admiralty Yd.).	" July 10, 1911.
Gangoot	23,000	" "	" Oct. 7, 1911.
Emperor Alexander III.	22,000	Ivan Bunge Co. (Clydebank).	Building.
Empress Marie	22,000	" "	"
Catherine II	22,000	Nikolaieff (Vickers).	"

THIS YEAR'S PROGRAM.—The naval estimates for 1911, ordinary and extraordinary expenditures, amount to $58,749,655. In addition to these estimates the sum of $15,463,390 was asked for the reequipment of the yards and works under the Ministry of Marine and a further sum of $14,000,000 for new ship constructions, making a total of $88,633,045.

Russia at present has under construction four battleships of 23,000 tons displacement, all of which were launched this year. Contracts were recently awarded for the construction of the following ships, intended for the Black Sea fleet: Three battleships of 22,000 tons displacement, nine destroyers of 1050 tons displacement, and six submarines. The strength of the naval personnel will be increased by 5000 men in 1912.

The Russian Admiralty has proposed a new naval program which provides for three fleets—the Baltic, the Black Sea, and the Pacific; the Baltic to consist of 16 battleships, eight armored cruisers, 16 cruisers, 36 destroyers, and 12 submarines; the Black Sea fleet to consist of a single division, intended to be one and a half times as strong as the naval forces at the disposal of powers in those waters; the Pacific fleet to consist of two cruisers, 18 torpedo vessels, 12 submarines, and three mining vessels. This program has not yet been authorized by the Duma.—*Army and Navy Register.*

NEXT YEAR'S PROGRAM.—The new program of construction for the Baltic soon to be discussed by the council of ministers, covers a period of five years and includes the establishment of new naval bases in the Baltic, besides the refitting of existing bases. Besides the vessels now under construction it is proposed to lay down four battle-cruisers in addition to a considerable number of destroyers and submarines.—*Army and Navy Register.*

THE NEW BATTLESHIPS.—On October 30, 1912, the following battleships were laid down: *Alexander III* and *Empress Marie* at the John Brown works, and the *Catharine II* at Vickers. These ships have the following characteristics: Displacement, 22,500 tons; length, 551 feet; beam, 89.5 feet; draft, 27.5 feet; speed, 21 knots; four turbines; 20 boilers; fuel capacity, 3000 tons. There are four triple turrets for the twelve 12-inch guns, twelve 6-inch guns; two under-water torpedo-tubes. The substitution of 14-inch guns for the 12-inch is under consideration.

The four Russian battleships of the *Gangut* class are now afloat, and it is stated that their places will be taken on the stocks in the Baltic yards by four battle-cruisers of 27,000-28,000 tons and 24 knots, armed with 14-inch guns, probably ten in number. The cost of each vessel is not to exceed £3,000,000. It is also stated that twelve large destroyers and a number of submarines are to be built, the total cost of the whole program being £16,000,000.—*Journal of the Royal Artillery.*

MINE LAYER.—The cruiser *Bogatyr* has been fitted as a mine layer.

TORPEDO VESSELS.—The new North Sea torpedo vessels will displace 1110 tons, and be 316.5 feet long; 30.5 feet beam; drawing 9.1 feet; 22,500 horse-power; three shafts, Parsons' turbines, five boilers; speed of 35 knots; three 4-inch guns; five 18-inch torpedo-tubes; and have a crew of seven officers, six petty officers, and 80 men.

In the Baltic, nine torpedo-boats and four submarines are under construction.

BLACK SEA FLEET.—Vice-Admiral Bostvem, former commander of the Black Sea fleet, has been dismissed from his post, by verdict of the court-martial which has been investigating the circumstances of, and trying him for, the grounding of the battleships *Panteleimon* and *Evstafi*, off Kustenji, in October.

Vice-Admiral Bostvem was found guilty of neglect of duty in not taking proper precaution or issuing proper orders to prevent the grounding of the ships.—*The Navy.*

SPAIN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
España*.....	15,400	Ferrol	Building.
Alfonzo XIII.....	15,400	"	Launched.
Jaime I.....	15,400	"	Ordered.

* *España:* Displacement, 15,700 tons; horse-power, 15,500 = 19.5 knots; guns, 8 12-inch, 50 cal., 6800; 20 4-inch.

The new Spanish Navy, for which a British syndicate is acting as sponsor, will consist of three battleships of the *Dreadnought* type, three destroyers, 24 torpedo-boats, and three submarines. On the moderate displacement of 15,700 tons an excellent and powerful type of battleship has been evolved. The *Espana* has not yet been launched, but is due for completion towards the close of next year; the *Alphonso XII* is on the stocks, and the *Jaime I*, which will not be completed until 1915, is preparing to build. The main armament of eight 12-inch 50-caliber is mounted as in the *Invincibles*, with the two amidships turrets *en échelon*, so that the broadside is from eight and the axial fire fore and aft from six guns. As in normal British practice the torpedo-repelling guns are 4-inch 31-pounders, but they are arranged, owing to the absence of superstructures, in a main-deck battery consisting of ten guns a-side. Unfortunately, since the average freeboard is only 17-18 feet, these weapons will probably be very difficult to handle in bad weather. The usual Parsons' turbines of 15,500 horse-power will enable these ships to maintain a speed of 19.5 knots or more. Adequate protection, in spite of the slight displacement, is afforded by a complete 8-inch belt, the battle guns being protected by the same thickness, and the secondary battery by 3-inch armor.—*Naval and Military Record.*

SMALLER CRAFT.—Spain has contracted with a British syndicate for three destroyers, 24 torpedo-boats, and three submarines.—*The Navy.*

TURKEY.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Reshad V.....	23,000	Elswick.	Laid down in December
Rechadie-Hamess.....	23,000	Vickers.	" " November.

ORDERS FOR BATTLESHIPS.—Official confirmation is given of the order to Messrs. Vickers, of Barrow-in-Furness, for one of two super-*Dreadnoughts*, for the Turkish Navy, the other order going to Messrs. Armstrong, of Newcastle. These vessels will be of about 23,000 tons displacement, and will have a speed of 21 knots. Parsons' turbines are to be used. The guns of each ship will include ten 14-inch weapons, the largest yet placed in any warship, and a secondary armament of sixteen 6-inch guns.—*Naval and Military Record.*

Although her navy has presented a pathetic spectacle during the present disagreement in the Mediterranean, Turkey will one day be able to boast of two magnificent fighting units of the best type. These ships, destined to be known as the *Reshad-i-Hamiss* and *Reshad V*, have been ordered from the firms of Vickers and Armstrong's respectively, and from particulars which have been made known they will be similar in most respects to the British *Orions*, with the exception that the secondary armament is believed to consist of sixteen 6-inch, mounted in a well-protected main-deck battery and reinforced by a large number of machine guns.—*Naval and Military Record.*

UNITED STATES.

VESSELS BUILDING.

No.	Name.	Speed. Knots.	Where Building.	% of Completion Dec. 1.	Jan. 1.	Feb. 1.	Mar. 1.
	Battleships.						
32	Wyoming....	20½	Wm. Cramp & Sons.	84.	88.	90.8	93.5
33	Arkansas....	20½	N. Y. Shipbuilding Co.	81.2	84.5	88.	90.9
34	New York...	21	Navy Yard, New York.	16.6	20.5	23.9	26.8
35	Texas.....	21	N'pt News S. B. Co.	44.4	48.1	51.3	56.1
36	Nevada	20.5	Fore River Co.	Contract awarded.			
37	Oklahoma ...	20.5	N. Y. Shipbuilding Co.	"	"		

BIDS FOR U. S. BATTLESHIPS.—Bids were opened at the Navy Department January 4 for the construction of the battleships *Nevada* and *Oklahoma*, authorized by the last Congress. The vessels are to have a displacement of 27,500 tons, a speed of 20.5 knots, and the cost, exclusive of armament and armor, was fixed by Congress at not more than $6,000,000 each. The bids were as follows:

Fore River Shipbuilding Co., Quincy, Mass., one vessel, with hull and machinery according to plans of the Navy Department, $5,980,000 for one vessel with Curtis turbine engines, $5,935,000; one vessel with reciprocating engines of the bidder's design, $5,955,000.

New York Shipbuilding Co., Camden, N. J., hull, equipment and machinery, according to the Department's designs, but with the substitution of nickel-steel for special treatment steel in portions of the ship, $5,926,000 and $5,965,000.

Newport News Shipbuilding & Drydock Co., Newport News, Va., one ship with hull and machinery according to the Navy Department plans, $6,450,000; two ships at $6,350,000 each.

William Cramp & Sons, Philadelphia, sent a letter announcing that because the eight-hour restriction imposed by Congress would require putting their whole plant on an eight-hour basis they would not make any proposals for either of the two battleships.

The Bethlehem Steel Co., Bethlehem, Pa., proposed to furnish 13,104 tons of Class A armor at $420 a ton and 1674 tons at $480 a ton; Class B armor at $470 per ton for 445 tons, and Class C armor at $508 per ton for 130 tons.

The Carnegie Steel Co., Pittsburgh, Pa., offered to furnish 13,104 tons at $420 per ton; 1674 tons for $480; Class B at $460 for 445 tons, and Class C at $508 per ton for 130 tons.

The Midvale Steel Co., Philadelphia, Pa., offered to furnish 1674 tons at $480 per ton; 13,104 tons at $420 per ton; Class B at $470 per ton for 445 tons, and Class C at $508 per ton for 130 tons.

The *Oklahoma* and *Nevada* will displace 500 tons more than the largest battleships now under construction. The port armor plates of the two three-gun turrets will be 18 inches in thickness, and as far as known the heaviest armor plate of modern construction afloat. The port plates on the two two-gun turrets will be 16 inches in thickness, and thicker than any armor plate on any other vessel under construction by the navy.

By the specifications under which the bids were let the *Nevada* and *Oklahoma* will carry heavier armor throughout than any ship afloat or under construction. The side armor will be 13 inches in thickness, as compared with 11 inches on the *New York* and *Texas*, which are the heaviest armored ships under construction. There will be about a thousand more tons of armor plate on the *Nevada* and *Oklahoma* than on the *New York* and *Texas*.

In a number of other respects the *Nevada* and *Oklahoma* will be a radical departure in naval construction. They will have only one funnel, with three-gun turrets fore and aft and will be oil burners.

BATTLESHIP CONTRACTS AWARDED.—The Navy Department has awarded to the Fore River Shipbuilding Co., at a cost of $5,935,000, a contract for one of the two new battleships authorized at the last session of Congress, and to the New York Shipbuilding Co., at a cost of $5,926,000, the contract for the other. These contracts are for the vessels exclusive of armor and armament.

The *Nevada* (No. 36), the ship to be built by the Fore River Co., will have Curtis turbines, and the *Oklahoma* (No. 37), to be built by the New York Shipbuilding Co., will have reciprocating engines.—*The Navy.*

A 30,000-TON BATTLESHIP.—There are statements in the American press seeming to show that the Navy Department intends to ask Congress for authority to build a battleship of 30,000 tons. It is argued that it will be

well to take a bold step, and to place in a ship of large displacement all the offensive and defensive power, and the best speed attainable. The limiting condition, so far as the United States fleet is concerned, is the depth of the Panama Canal, but 30,000 tons is a possible displacement. American papers say that there is a moral advantage in leading the world. The objectors argue that such a ship as is mentioned would cost too much, but the same reason is advanced against building two battleships instead of one, and, if pushed to a logical extremity, it would lead to provision being made for no battleships at all. The characteristics of heavier armament, better protection, higher speed, longer range of action, and greater endurance are held to increase over the best existing type with every additional ton of displacement.—*Army and Navy Gazette.*

The new torpedo-boat destroyers ordered by the United States Navy Department are distinctly larger than those of last year's program, being 1010 tons total displacement and 300 feet long. The speed is to be 29 knots with 16,000 shaft horse-power, though it is probable that this will be largely exceeded, as was the case with the earlier boats. The time required to build was in all cases 24 months, while the prices quoted for the boats without armament varied from £148,000 to £164,000, several contracts being placed at £152,000. These prices and time to construct are both distinctly greater than obtain in this country. In the boats ordered from Messrs. Cramp, Zoelly turbines will be found.—*The Engineer.*

THE "FANNING."—The torpedo-boat destroyer *Fanning*, authorized by Act of Congress of June 24, 1910, was launched at the yards of the Newport News Shipbuilding & Dry Dock Co., on January 11, 1912.

The destroyer's normal displacement is 742 tons; full load displacement, 883 tons; highest speed on trial (estimated), 29.50 knots; length, over all, 293 feet 10 inches; breadth on load water-line, 26 feet 1½ inches; mean hull draft, 8 feet 4 inches; estimated bunker capacity for fuel oil, 65,974 gallons. She will have three masts and two funnels. The contract price was $630,500.

The *Fanning* has Parsons' turbines, with four Thornycroft boilers. Her generating sets were built by the Terry-Diehl Co., and are 2 kilowatt 5-volt sets. She is armed with five 3-inch 50-caliber rapid-firing guns, and three twin 18-inch torpedo-tubes, carrying six torpedoes; and will have a complement of four officers and 79 men.

The *Fanning* is named for Nathaniel Fanning, of Stonington, Connecticut. He was appointed lieutenant in the United States Navy, December 5, 1804; died October 24, 1805.

Fanning was a midshipman on the *Bonhomme Richard*, and was commended by John Paul Jones for his bravery and prompt obedience to orders; captain of the maintop in the engagement between the *Bonhomme Richard* and the *Serapis*, September 23, 1779. When the most of his men had been killed, he took a fresh gang into the top and succeeded in clearing the tops of the *Serapis* of her men; passed, with his men, when the yards of the ships were locked, from the *Bonhomme Richard* to the *Serapis;* and, directing the fire of his men with hand grenades and other missiles, drove the British seamen from the stations. When recommending Fanning for promotion, Jones said, "He was one cause among the prominent in obtaining the victory."

He accompanied John Paul Jones from the *Bonhomme Richard* to the *Serapis*, and, when Jones was obliged to give up that ship, to the *Alliance*. Jones obtained a position for him on one of the French privateers.—*The Navy.*

SUBMARINES "F-3" AND "F-4."—The submarine torpedo-boats *F-3* and *F-4* (formerly known as Nos. 22 and 23, respectively), were launched by the Seattle Shipbuilding and Dry Dock Co., at Seattle, Wash., on January 6, 1912.

These boats were authorized under the Act of May 13, 1908. The contract price for each is $455,740.—*The Navy.*

NOTES ON SHIPBUILDING PROGRAMS.

The following is the warship tonnage in case vessels now building are considered as completed:

Nations.	Tonnage.
Great Britain	2,324,579
Germany	1,087,399
United States	885,066
France	741,425
Japan	590,119
Russia	473,879
Italy	312,122
Austria	267,442

An examination of the shipbuilding programs of the principal naval powers shows that great activity in warship construction is everywhere manifest at the present time. The manner in which the policy of the all-big-gun battleship now find universal acceptance is particularly illustrated. This is now the only type of battleship constructed, for all of the old-type battleships still under construction at the beginning of this year will have been completed before the end of the year and no more are contemplated.

The year has seen the completion of a new type of *Dreadnought*, namely, the *Orion*, of the British Navy, the first to be armed with 13.5-inch guns and also the first foreign battleship to be completed in which all the turrets are placed in the center line of the ship, the system already in use in the United States Navy.

As noted in the last annual report, a new type of armored cruiser, now called battle-cruiser, is being constructed, but only by Great Britain, Germany, and Japan. Russia is reported as about to do the same. The policies of these countries in this matter, however, are not alike, for, while England is laying down four battleships and one armored cruiser, Germany three battleships and one armored cruiser, Japan reverses the procedure, and her program calls for four armored cruisers and one battleship. The latest of these vessels for England and Japan will displace about 27,000 tons and will carry either 13.5-inch or 14-inch guns.

Not only has there been an increase in the size of capital ships, but also in the displacements of cruisers, destroyers, and submarines. The latest protected cruisers have a displacement of over 5000 tons, destroyers are being designed for 900 to 1000 tons and over, while England and France have ordered submarines which are reported to have over 900 tons submerged displacement and are designed to accompany the battleship fleet in the same manner as destroyers.

Italy and Austria are the only naval powers now building torpedo-boats. —*Army and Navy Register.*

Great Britain, Germany, and Japan have all laid down floating docks able to dock their largest vessels.

The following tables comprise the latest detailed information regarding vessels building, and are of interest. From the *Engineer:*

ARMORED SHIPS LAUNCHED IN 1911

ARMORED SHIPS LAUNCHED IN 1911

Name	Builders	Launched	Normal displacement	Armament	H. P.	Speed	Machinery	Boilers	Builders of machinery
BRITISH—			*Tons*						
Conqueror	Beardmore	May 1	23,500	10 13.5-in., 20 4-in	27,000	21	Parsons turbine.	Babcock	Beardmore
Monarch	Elswick	March 30	23,500	10 13.5-in., 20 4-in	27,000	21	Parsons turbine.	Babcock	Hawthorn
Thunderer	Thames Ironworks	Feb. 1	23,500	10 13.5-in., 20 4-in	27,000	21	Parsons turbine.	Babcock	Thames Ir'nw'ks
Centurion	Devonport Yard	Nov. 18	25,000	10 13.5-in., 20 4-in	31,000	21	Parsons turbine.	Yarrow	Hawthorn
King George V	Portsmouth Yard	Oct. 9	25,000	10 13.5-in., 20 4-in	31,000	21	Parsons turbine.	Babcock	Hawthorn
Princess Royal	Vickers	April 29	25,000	8 13.5-in., 20 4-in	70,000	28	Parsons turbine.	Yarrow	Vickers
BRITISH COLONIAL—									
Australia	Clydebank	Oct. 25	19,100	8 12-in., 16 4-in	44,000	25	Parsons turbine.	Babcock	Clydebank
New Zealand	Fairfield	July 1	19,100	8 12-in., 16 4-in	44,000	25	Parsons turbine.	Babcock	Fairfield
ARGENTINE—									
Rivadavia	Fore River Co	Aug. 26	25,000	12 12-in., 12 6-in., 12 4-in.	30,500	22.5	Curtis turbine	Babcock	Fore River
Moreno	N. Y. Shipbuilding	Sept. 23	25,000	12 12 in., 12 6-in., 12 4-in.	30,500	22.5	Curtis turbine	Babcock	Fore River
AUSTRIAN—									
Viribus Unitis	Stabilimento Tecnico	June	20,000	12 12-in., 12 6-in	26,000	21	Parsons turbine.	Yarrow	Stab. Tecnico
FRENCH—									
Jean Bart	Brest Yard	Sept. 22	23,500	12 12-in., 22 5.5-in	29 000	20	Parsons turbine.	Niclausse	
Courbet	Lorient Yard	Sept. 23	23,500	12 12-in., 22 5.5 in	29,000	20	Parsons turbine.	Belleville	
GERMAN—									
Kaiser	Kiel Yard	June 10	23,000	(*a*) 10 14-in., 14 6-in, or	27,000	20.5	Parsons turbine.	Thornycroft.	Kiel
Friedrich der Grosse	Vulcan, Hamburg	March 23	23,000	(*b*) 15 12.2-in., or	27,000	20.5	Parsons turbine.	Thornycroft.	Vulcan
Kaiserin	Howalt, Kiel	Nov. 11	23,000	(*c*) 10 12.2-in. (See note)	27,000	20.5	Parsons turbine.	Thornycroft.	Howalt
Goeben	Blohm & Voss	March 28	23,000	10 11-in., 12 6-in	60,000	28	Parsons turbine.	Thornycroft.	Blohm & Voss
ITALIAN—									
C. di Cavour	Spezia Yard	Aug. 10	21,500	13 12-in., 18 4.7-in	24,000	22.5	Parsons turbine.	Blechynden	Orlando
L. da Vinci	Ansaldo, Armstrong	Nov. 14	21,500	13 12-in., 18 4.7-in	24,000	22.5	Parsons turbine.	Blechynden	Ansaldo
G. Cesare	Odero	Oct. 15	21,500	13 12-in., 18 4.7-in	24,000	22.5	Parsons turbine.	Babcock	Odero
JAPANESE—									
Setsu	Yokosuka Yard	April 1	20,750	14 (or 12) 12-in., 10 6-in., 12 4.7-in. (See note)	25,500	20	Parsons turbine.	Miyabara	In England (?)
RUSSIAN—									
Sevastopol	Baltic Works	June 29	23 300	12 12-in., 16 4.7-in	42,000	23	Parsons turbine.	Yarrow	Baltic Works
Petropavlovsk	Baltic Works	Sept. 9	23,300	12 12-in., 16 4.7-in	42,000	23	Parsons turbine.	Yarrow	Baltic Works
Poltava	New Admiralty Yd.	July 10	23 300	12 12-in., 16 4.7-in	42,000	23	Parsons turbine.	Yarrow	Franco-Russian
Gangoot	New Admiralty Yd.	Oct. 7	23,300	12 12-in., 16 4.7-in	42,000	23	Parsons turbine.	Yarrow	Franco-Russian
SPANISH—									
Alfonso XIII.	Ferrol	(1911)	15,700	8 12-in., 20 4-in	15,500	19.5	Parsons turbine.	Yarrow	Elswick
UNITED STATES—									
Arkansas	N. Y. Shipbuilding	Jan. 14	26,400	12 12 in., 21 5-in	28,000	20.5	Parsons turbine.	Babcock	N. Y. Shipb'ld'g
Wyoming	Cramp	May 25	26,400	12 12-in., 21 5-in	28,000	20.5	Parsons turbine.	Babcock	Cramp

NOTE.—The armaments of the German ships, except Goeben, are doubtful. These ships follow the Neptune design, but it is entirely a matter of speculation whether they will carry (*a*) ten 14-in.; (*b*) fifteen 12.2-in. in triple turrets; (*c*) ten 12.2-in., and have speeds considerably in excess of normal German battleships. Of the three the last is rather the more probable.

It is also uncertain whether the foremost and aftermost turrets of the Japanese Setsu are designed for two guns each or three.

UNARMORED SHIPS LAUNCHED IN 1911

Name	Builders	Launched	Normal displacement	Armament	H. P.	Speed	Machinery	Boilers	Builders of machinery
BRITISH—			Tons						
Chatham	Chatham Yard	Nov. 9	5300	8 6-in	25,000	26	Curtis turbine	Yarrow	Thames Ir'n w'ks
Dartmouth	Vickers	Feb. 14	5250	8 6-in	25,000	25	Parsons turbine	Yarrow	Vickers
Yarmouth	London & Glasgow	April 12	5250	8 6-in	25,000	25	Curtis turbine	Yarrow	London & Glas.
Active	Pembroke	March 14	3400	10 4-in	18,000	25	Parsons turbine	Yarrow	Hawthorn
Amphion	Pembroke	Decemb'r	3400	10 4-in	18,000	25	Parsons & Curtis	Yarrow	Hawthorn
Maidstone	Vickers		3600			14	Reciprocating		Vickers
Adamant	Laird		950			14	Reciprocating		Laird
Alecto	Laird		950			14	Reciprocating		Laird
CHINESE—									
Chao-Ho	Elswick	Oct. 23	2750	2 6-in., 4 4-in	8,000	22	Parsons turbine	Yarrow and cylindrical	Hawthorn Vickers
Ying-Swei	Vickers	June 14	2750	2 6-in., 4 4-in	8,000	22	Parsons turbine		
CUBAN—									
Cuba	Cramp		2055	2 4-in		18	Reciprocating	Babcock	Cramp
Patria	Cramp		1700	1 12-pdr		17	Reciprocating	Babcock	Cramp
DUTCH—									
Hydra	Amsterdam	(1911)	670	3 12-pdr		10	Reciprocating	Yarrow	
Medusa	Amsterdam	(1911)	670	3 12-pdr		10	Reciprocating	Yarrow	
GERMAN—									
Breslau	Vulcan, Stettin	May 16	4750	Probably 2 6-in., 10 4-in. (See note)	30,000	28	A.E.G. (Curtis) t.	Schulz T	Vulcan Co.
Magdeburg	Weser, Bremen	May 13	4750		30,000	28	Bergmann tur.	Schulz T	Weser
Strassburg	Weser, Bremen	Aug. 24	4750		30,000	28	Parsons turbine	Schulz T	Weser
Stralsund	Wilhelmshaven Y	Nov. 4	4750		30,000	28	Bergmann tur.	Schulz T	Wilhelmshaven
ITALIAN—									
Quarto	Venice Yard	Aug. 19	3300	6 4.7-in	22,500	28	Parsons turbine	Blechynden	(?)
JAPANESE—									
Hirado	Kawasaki	June 29	4800	6 6-in	22,500	26	Curtis turbine	Miyabara	Mitsu Bishi
Shikuma	Sassebo Yard	March 30	4800	6 6-in	22,500	26	Parsons turbine	Miyabara	Mitsu Bishi
Yahagi	Mitsu Bishi	Oct. 3	4800	6 6 in	22,500	26	Curtis turbine	Miyabara	Mitsu Bishi
SPANISH—									
Bonifaz	Cadiz	(1911)	813	4 12-pdr	1,100	13	Reciprocating	Yarrow	Cadiz
Lauria	Cadiz	(1911)	813	4 12-pdr	1,100	13	Reciprocating	Yarrow	Cadiz
Laya	Cadiz	(1911)	813	4 12-pdr	1,100	13	Reciprocating	Yarrow	Cadiz
Recalde	Cadiz	(1911)	813	4 12-pdr	1,100	13	Reciprocating	Yarrow	Cadiz
TURKISH—									
Drama	Ansaldo		3800	2 6-in., 8 4.7-in	12,000	22	Reciprocating	Niclausse	Ansaldo

NOTE.—Armament of the German cruisers is uncertain.

ARMORED SHIPS LAID DOWN IN 1911

Name	Builders	Laid down	Normal displacement	Armament	H. P.	Speed	Machinery	Boilers	Builders of machinery
BRITISH—			Tons						
Agincourt	Fairfield		27,500	14 12-in., 20 4-in	40,000	23	Parsons turbine	Yarrow	Fairfield
Benbow	Portsmouth Yard		25,000	10 13.5-in., 16 4-in	25,000	21	Parsons turbine	Yarrow	Portsmouth Yard
Emperor of India	Devonport Yard		25,000	10 13.5-in., 16 4-in	25,000	21	Parsons turbine	Yarrow	Devonport Yard
Iron Duke	Portsmouth Yard		25,000	10 13.5-in., 16 4-in	25,000	21	Parsons turbine	Yarrow	Portsmouth Yard
Monarch	Devonport Yard		25,000	10 13.5-in., 16 4-in	25,000	21	Parsons turbine	Yarrow	Devonport Yard
Orion	Portsmouth Yard		25,000	10 13.5-in., 16 4-in	25,000	21	Parsons turbine	Yarrow	Portsmouth Yard
Ajax	Devonport Yard		25,000	10 13.5-in., 16 4-in	25,000	21	Parsons turbine	Yarrow	Devonport Yard
Centurion	Portsmouth Yard		25,000	10 13.5-in., 16 4-in	25,000	21	Parsons turbine	Yarrow	Portsmouth Yard
Conqueror	Devonport Yard		25,000	10 13.5-in., 16 4-in	25,000	21	Parsons turbine	Yarrow	Devonport Yard
Hercules	Portsmouth Yard		25,000	10 13.5-in., 16 4-in	25,000	21	Parsons turbine	Yarrow	Portsmouth Yard
Indomitable	Devonport Yard		25,000	10 13.5-in., 16 4-in	25,000	21	Parsons turbine	Yarrow	Devonport Yard
Indefatigable	Devonport Yard		18,750	8 12-in., 16 4-in	44,000	25	Parsons turbine	Yarrow	Devonport Yard
New Zealand	Fairfield		18,750	8 12-in., 16 4-in	44,000	25	Parsons turbine	Yarrow	Fairfield
Australia	Fairfield		18,750	8 12-in., 16 4-in	44,000	25	Parsons turbine	Yarrow	Fairfield
Lion	Devonport Yard		26,350	8 13.5-in., 16 4-in	70,000	28	Parsons turbine	Yarrow	Devonport Yard
Princess Royal	Vickers		26,350	8 13.5-in., 16 4-in	70,000	28	Parsons turbine	Yarrow	Vickers
Queen Mary	Portsmouth Yard		26,350	8 13.5-in., 16 4-in	70,000	28	Parsons turbine	Yarrow	Portsmouth Yard
Tiger	Elswick		26,350	8 13.5-in., 16 4-in	70,000	28	Parsons turbine	Yarrow	Hawthorn
CHILIAN—									
Almirante Latorre	Armstrong		28,000	10 14-in., 16 6-in	40,000	25	Parsons turbine	Yarrow	Armstrong
Almirante Cochrane	Armstrong		28,000	10 14-in., 16 6-in	40,000	25	Parsons turbine	Yarrow	Armstrong
GERMAN—									
Derfflinger	Vulcan, Stettin		26,000	8 12-in., 12 5.9-in	72,000	27	A.E.G. (Curtis) t.	Schulz T	Vulcan Co.
Lutzow	Vulcan, Hamburg		26,000	8 12-in., 12 5.9-in	72,000	27	A.E.G. (Curtis) t.	Schulz T	Vulcan Co.
Moltke	Blohm & Voss		22,640	10 11-in., 12 5.9-in	70,000	28	Bergmann tur.	Schulz T	Blohm & Voss
Seydlitz	Germania		22,640	10 11-in., 12 5.9-in	70,000	28	Bergmann tur.	Schulz T	Germania
Von der Tann	Germania		19,700	8 11-in., 10 5.9-in	43,000	25	Bergmann tur.	Schulz T	Germania
ITALIAN—									
Caio Duilio	Ansaldo		23,000	10 12-in., 16 4.7-in	30,000	21	Parsons turbine	Blechynden	Ansaldo
Andrea Doria	Ansaldo		23,000	10 12-in., 16 4.7-in	30,000	21	Parsons turbine	Blechynden	Ansaldo
JAPANESE—									
Kongo	Vickers		27,500	8 14-in., 16 6-in	64,000	27	Parsons turbine	Yarrow	Vickers
Hiyei	Yokosuka Yard		27,500	8 14-in., 16 6-in	64,000	27	Parsons turbine	Yarrow	Yokosuka Yard
Kirishima	Kawasaki		27,500	8 14-in., 16 6-in	64,000	27	Parsons turbine	Yarrow	Kawasaki
Haruna	Kure Yard		27,500	8 14-in., 16 6-in	64,000	27	Parsons turbine	Yarrow	Kure Yard
SPANISH—									
Espana	Ferrol Yard		15,700	8 12-in., 16 4.7-in	15,000	18	Reciprocating	Yarrow	Ferrol Yard
Alfonso XIII	Ferrol Yard		15,700	8 12-in., 16 4.7-in	15,000	18	Reciprocating	Yarrow	Ferrol Yard
TURKISH—									
Reshadieh	Armstrong		23,000	10 13.5-in., 16 4-in	25,000	21	Parsons turbine	Yarrow	Armstrong
Sultan Osman I	Armstrong		23,000	10 13.5-in., 16 4-in	25,000	21	Parsons turbine	Yarrow	Armstrong

Drama	Ansaldo		3800	2 6-in., 8 4.7-in	12,000	23	Reciprocating...	Niclausse....	Ansaldo

NOTE.—Armament of the German cruisers is uncertain.

ARMORED SHIPS LAID DOWN IN 1911

Name	Builders	Laid down	Normal displacement	Armament	H. P.	Speed	Machinery	Boilers	Builders of machinery
			Tons						
BRITISH—									
Ajax	Scott's Shipbldg. Co.	Feb. 27....	25,000	10 13.5-in., 20 4-in	31,000	21	Parsons turbine.	Babcock	Scott's
Audacious	Laird	March 23.	25,000	10 13.5-in., 20 4-in	31,000	21	Parsons turbine.	Not settled..	Cammell Laird
King George V	Portsmouth Yard...	Jan. 16 ...	25,000	10 13.5-in., 20 4-in	31,000	21	Parsons turbine.	Babcock	Hawthorn
Centurion	Devonport Yard....	Jan. 16 ...	25,000	10 13.5-in., 20 4-in	31,000	21	Parsons turbine.	Yarrow	Hawthorn
Queen Mary	Palmer	March 6..	28,850	8 13.5-in., 16 4-in	80,000	28	Parsons turbine.	Yarrow	Clydebank
AUSTRIAN—									
No. VI	Stablimento Tecnico	August...	20,000	12 12-in., 12 6-in	26,000	20.5	Parsons turbine.	Yarrow	Stab. Tecnico
BRAZILIAN—									
Rio de Janeiro	Elswick	Sept. 14...	27,500	14 12-in., 20 6-in	(?)	22	Parsons turbine.	Babcock	Hawthorn
CHILIAN—									
Constitucion	Elswick	Nov. 27...	27,500	10 13.5-in., 16 6-in	45,000	23	Parsons turbine.		
Libertad	Vickers	Decemb'r	27,500	10 13.5-in., 16 6-in	45,000	23	Parsons turbine.		Vickers
DANISH—									
Unnamed	Copenhagen	(1911)	3,740	2 9.4-in., 4 6-in	5,400	15.9	Reciprocating...	Thornycroft.	
FRENCH—									
Paris	La Seyne	Nov'mb'r	23,500	12 12-in., 22 5.5-in	29,000	20	Parsons turbine.	Belleville	La Seyne
France	St. Nazaire	Nov'mb'r	23,500	12 12-in., 22 5.5-in	29,000	20	Parsons turbine.	Niclausse	St. Nazaire
GERMAN—									
"S"	Wilhelmshaven Yd.	May		10 or 12 14-in. (See notes)			Parsons turbine.	Schulz T	Wilhelmshaven
E.—K. F. Wilhelm	Vulcan, Hamburg	July					Parsons turbine.	Schulz T	Vulcan Co.
E.—Weissenburg	Weser, Bremen	July					Parsons turbine.	Schulz T	Wesser
"K"	Blohm & Voss	Sept'mb'r	(?)	10 12.2-in. or else 8 14-in (See notes)		28	Parsons turbine.	Schulz T	Blohm & Voss
ITALIAN—									
"F"	Castellamare	October..	26,000	12 13.5-in		22		Yarrow	
"G"	Spezia	Decemb'r	26,000	12 13.5-in		22		Yarrow	
JAPANESE—									
Kongo	Vickers	Jan. 17 ...	27,500	8 13.5-in., 16 6-in	64,000	25	Parsons turbine.	(?)	Vickers
Hi-Yei	Yokosuka Yard	August...	27,500	8 13.5-in., 16 6-in	64,000	25	Parsons turbine.	Miyabara	(?)
Fu-So	Kure	Decemb'r	(?)	(?)	(?)	(?)	(?)	(?)	(?)
RUSSIAN—									
Imp. Maria	Ivan Bunge Co. (Clydebank)	Oct. 30....	22,500	12 12 in., 20 4.7-in	25,000	21	Turbine	(?)	Clydebank
Imp. Ekaterina II	Nikolaieff (Vickers).	Oct. 30....	22,500	12 12-in., 20 4.7-in	25,000	21	Turbine	(?)	Vickers
Imp. Alexander III.	Ivan Bunge Co. (Clydebank)	Oct. 30....	22,500	12 12-in., 20 4.7-in	25,000	21	Turbine	(?)	Clydebank
SPANISH—									
Don Jamie	Ferrol	(1911)	15,700	8 12-in., 20 4-in.	15,500	19.5	Parsons turbine.	Yarrow	Elswick
TURKISH—									
Rechad V.	Elswick	Decemb'r	23,000	10 13.5-in., 16 4.7-in	31,000	21	Parsons turbine.		Vickers
Rechadie-Hamiss	Vickers	Nov'mb'r	23,000	10 13.5-in., 16 4.7-in	31,000	21	Parsons turbine.		Vickers
UNITED STATES									
New York	New York Yard	January .	27,000	10 14-in., 21 5-in	32,000	21	Parsons turbine.	Babcock	Cramp
Texas	Newport News	February	27,000	10 14-in., 21 5-in	32,000	21	Reciprocating...	Babcock	Newport News

NOTE.—There is some slight doubt as to whether the Rechad V. can be officially considered as laid down in 1911, a remark which also applies to the Libertad.

German armaments doubtful.

UNARMORED SHIPS LAID DOWN IN 1911

Name	Builders	Laid down	Normal displacement	Armament	H. P.	Speed	Machinery	Boilers	Builders of machinery
			Tons						
British—									
Cruiser A	Elswick	October..	5500	8 6-in	25,000	26	Turbine	Yarrow	Hawthorn
Cruiser B	Vickers	October..	5500	8 6-in	25,000	26	Turbine	Yarrow	Vickers
Cruiser C	Beardmore	October..	5500	8 6-in	25,000	26	Turbine	Yarrow	Beardmore
Scout (unnamed)	Pembroke Yard	Nov. 15...	3300	10 4-in	18,000	25	Parsons turbine.	Yarrow	
Austrian—									
G	Malfoncane	(1911)	3500	7 4-in	25,000	27	Parsons turbine.	Yarrow	Danubius W.
H	Fiume	(1911)	3500	7 4-in	25,000	27	Parsons turbine.	Yarrow	Danubius W.
Dutch—									
A	Amsterdam	(1911)	540	4 4.1-in	1,200	16	Motor (oil)		Diesel
B	Amsterdam	(1911)	540	4 4.1-in	1,200	16	Motor (oil)		Diesel
C	Amsterdam	(1911)	540	4 4.1-in	1,200	16	Motor (oil)		Diesel
German—									
E—Seeadler	Krupp	July 11...	(?)	(?)	(?)	28			Krupp
E—Geier	Howalt	October..	(?)	(?)	(?)	28			Howalt
Italian—									
Nino Bixio	Castellamare	(1911)	3600	6 4.7-in	25,000	28	Parsons turbine.	(?)	
Marsala	Castellamare	(1911)	3600	6 4.7-in	25,000	28	Parsons turbine.	(?)	
Sebastiano Cabot	Palermo	(1911)	(?)	(?)	(?)	..			
Turkish—									
1	Schneider Canet	(1911)	510	4 12-pdr	(?)	14	Reciprocating		Schneider
2	Schneider Canet	(1911)	510	4 12-pdr	(?)	14	Reciprocating		Schneider
3	Schneider Canet	(1911)	510	4 12-pdr	(?)	14	Reciprocating		Schneider
4	Schneider Canet	(1911)	510	4 12-pdr	(?)	14	Reciprocating		Schneider
5	Schneider Canet	(1911)	510	4 12-pdr	(?)	14	Reciprocating		Schneider
6	Schneider Canet	(1911)	510	4 12-pdr	(?)	14	Reciprocating		Schneider
United States—									
Sacramento	(?)	(1911)	(?)	(?)	(?)	15	(?)	(?)	(?)

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NOTE.—One other British scout is on the program, 1911-12, but not yet laid down.
The Austrians are slightly enlarged copies of the Admiral Spaun.
Nothing whatever is known of the German cruisers beyond the meager details given above. It is presumed that they are of about 5000 tons, carrying either twelve 4.1-in., or else some 6-in. guns.
The Italians are slightly enlarged duplicates of the Quarto. The S. Cabot is a gunboat of which no details have been published.
The Turkish vessels are duplicates of the Marmaris, for customs duty, etc.
Nothing is known of the Sacramento except what is here recorded. It is understood, however, that she is merely a gunboat for police duties.

ORDNANCE AND GUNNERY.

SIZE OF GUNS.—The *Asahi* (Tokio) states that the Japanese naval authorities have no intention of mounting a heavier gun than the 12-inch in their new ships. The reasons given are that a greater rate of fire can be maintained with the smaller weapon, and that as the limits of vision make it impossible to fight at a greater range than 10,000 yards, the 12-inch gun, which can penetrate 28 cm. of armor at that range, is quite powerful enough.—*Journal of the Royal Artillery.*

LARGER ANTI-TORPEDO GUNS.—It is not quite likely that we shall soon see a larger gun than the present 4-inch quick-firer used in the capital ships of Great Britain as an anti-torpedo armament, since we are almost alone among first-class naval powers to use a weapon of so small a caliber for this purpose. Guns of 4.7-inch, 5-inch, 5.9-inch, and 6-inch, are the weapons chiefly used by foreign nations for beating off torpedo attack, and considering the excellent 6-inch guns that our manufacturers now turn out, and the amount of ammunition, stores, etc., we have in stock for the latest pattern of this gun, it is highly probable that we shall, if we move at all, step boldly from the 4-inch to the 6-inch gun for anti-torpedo defence. Behind armor, and carried well above the water-line, these weapons would be very effective, although no armor likely to be placed around them will protect them from the destructive fire of the present-day primary guns of battleships and large cruisers. Yet something will have to be done to meet the ever-increasing range of the Whitehead torpedo, of which the 21-inch —excellent weapon and great improvement that it is—is by no means the last word in mobile torpedo production. Already there are rumors of a torpedo of this description which will put the 21-inch very much in the shade, especially in regard to range. To meet such attack the 4-inch gun in British ships will have to give place to guns whose shots travel much further in aimed practice and which can be as easily and rapidly worked.—*United Service Gazette.*

FRENCH GUNNERY PROGRESS.—The interesting gunnery statistics which Deputé Lebail has just applied the Chamber, while testifying to gradual progress, show that the French fleet is not yet quite up to British standards, both for rate of fire and accuracy, mainly owing to the deficiency of the material that was notoriously designed for a slow rate of fire. Thus in 1905 the 12-inch, 7.6-inch and 6.4-inch ordnance (as fitted on board the *Brest* battleships and cruisers) only obtained an abnormally low rate, viz., one round per 2.5 minutes, one round per 1.36 minutes, and hardly two rounds per minute respectively. Today the same weapons (model 1893) fire, on an average, one shot per 1.1 minute, 2.2 shots and 3 shots per minute, which is poor enough, but very commendable when the out-of-date design of the guns is considered. Even the artillery of the *Patries* (1902-5) is not adapted to quick firing, the *Dantons* being the first ships in which this important point has received attention. Six years since battle practice took place at ranges not exceeding 3500 meters, and yet the target was missed 85 times out of every 100 shots. Today the range has been increased to nearly 8000 meters and the percentage of hits exceeds 20—rising exceptionally to over 50.—*Naval and Military Record.*

THE "DANTONS'" RATE OF FIRE.—The 18,000-ton French ships having been designed, like the British *Lord Nelsons*, with a view to combine penetration and volume of fire at moderate battle ranges (from 5000 to 7000 meters), it follows that whatever value is claimed for them will reside primarily in the rate of fire they are capable of attaining. Hence the intense disappointment in naval circles when it was announced recently that the 305 and 240 mm. weapons of the *Condorcet* had failed to come up to the stipulated rate of fire (two and three rounds per minute respectively). Happily these early results—due to the inexperience of guns' crews with

The Turkish vessels are duplicates of the Marmaris, for customs duty, etc.
Nothing is known of the Sacramento except what is here recorded. It is understood, however, that she is merely a gunboat for police duties.

the new material—have been corrected by the splendid performances just accomplished at Toulon and Brest. On board the *Voltaire*, 305-mm. guns were fired every 27 seconds (a rate of 2.2 rounds per minute), whilst a 240-mm. twin-turret obtained 32 shots in five minutes (at rate of 3.1 per gun and per minute). Still better was achieved in the *Diderot*, in which a 240-mm. turret fired 35 rounds in 5 minutes and 20 seconds, which works out at 3.4 per gun and per minute.

Although these performances of picked Frenchmen are not yet quite up to the service standard of the British Navy, which has in this respect an advance of many years, they are nevertheless highly creditable in view of the fact that the new French shells (in contrast with what existed previously) are considerably heavier than British projectiles of similar calibers. This success of the turret design of the *Dantons* (and also of the *Quinets*) has been heartily welcomed among Gallic naval men, who have long deplored that the shortcomings of the artillery material on board the *Patries* and earlier cuirassés should so effectively delay progress in the way of rapid and accurate firing, and consequently minimize the advantage which the naval service might have otherwise derived from the highly efficient gunnery personnel, supplied in adequate numbers by the Toulon "Ecole de Canonnage," as well as from the rational methods of battle practice adopted in the Toulon and Brest "Escadres." In the new 18,000-ton ships, however, up-to-date material will combine with the qualities of the personnel to create battle efficiency.—*Naval and Military Record.*

The Question of the Calibers.—Notwithstanding the decision of the Admiralty to fit 340-mm. weapons in the 1912 ships, and the fact that experimental guns of that caliber are being experimented with at Ruelle, the retention of the 305 mm. continues all the same to be advocated by a minority of naval men, who have just discovered a "fait nouveau" in favor of their contention in the prowess just accomplished at Gâvres by a 12-inch weapon similar to those in the *Dantons*. A Krupp plate 240 mm. (9.4-inch) thick was perforated, at a distance of 5000 meters, and under an angle of 40 degrees, by a 440-kilo "obus alourdi," which is indeed a very hard test, and points to remarkable penetration. It would be folly, they proclaim, to substitute for so perfect a piece of ordnance heavier calibers yet in the experimental stage, and certain, any way, not to combine to so great an extent destructive power with rate of fire. To this plea the Admiralty advisers retort by saying that the first duty of those responsible for naval construction is to look ahead and to provide for the ceaseless advance of maritime science. No more grievous mistake, they hold, could be made than to adhere to a type of weapon which already would prove hardly sufficient at long range, if pitted against the robust belt of a British *Orion*, and which, of course, will have no chance against the very thick armor of the super-*Dreadnoughts* of tomorrow. Only superior "instruments de combat" are truly economical, they add, and obsolete types of vessels can never be cheap. To reproduce next year the *Courbet* design would be a senseless waste of money, the 23,500-ton French ships being certain to be outclassed by the English, German, and American mastodons now building or ordered.—*Naval and Military Record.*

NAVY COMPETITIVE RIFLES.—Following the conference of navy officers last week in the office of the director of target practice and engineering competitions, the rules to govern battle practice in the spring have been completed and are now in the hands of the printer. A number of changes were made. Among them is the requirement that the minimum range of gun-fire shall be 12,000 yards, instead of 9000, as in the last practice. Torpedo practice, by both destroyers and submarines, will be at battleships as targets. The submarines will submerge at a minimum range of 10,000 yards. All the practice of destroyers will be at night, and a submarine night run will also be held. It has been decided to place the reserve fleets

of battleships and torpedo craft on both coasts on a competitive basis as to engineering, it being necessary to keep these vessels ready at all times, as far as the machinery is concerned, to go to sea. Three new competitions as to consumption of coal will be established, namely, for steam launches, evaporators and dynamos.—*Army and Navy Register.*

SHELL FIRE.—Reference was made in a recent letter to German progress in the direction of heavy projectiles. What has actually been done remains a secret, but reports have been heard of an approaching realization of the "six-caliber" shell ideal, free from the defects which militated against the general use of its prototype, the Japanese "portmanteau." Authorities all over the world are agreed that the destructive potentiality of a shell is measured by the size and power of the bursting charge, and not merely by the diameter of the projectile itself. A 6-inch or 8-inch shell penetrating 'twixt wind and water would be almost as damaging as one of 12-inch, in that the first would make an aperture quite large enough to permit the water to enter. On the other hand, the havoc wrought by the explosion of the 12-inch shell after penetration would be incomparably greater than that of a 6-inch or 8-inch. Generally speaking, gunners are confident of their ability to place shells inside the enemy's ship, but they are not yet satisfied with the disruptive effect of the shells, once they have reached that position. It is not impossible that projectile makers, in their anxiety to produce a shell which will perforate intact the hardest armor existing, have given insufficient consideration to the bursting charge. This is, at any rate, the German view. The most formidable 12-inch shell known is the Austrian. It weighs 1010 pounds, but the proportion of this weight contributed by the filling is uncertain. Another powerful projectile of the same diameter is the new French model, whose weight is understood to be 990 pounds. Two types of shell are used with the German 12-inch gun, the respective weights being 980 pounds and 875 pounds. The American shell weighs 870 pounds and the British 850 pounds. The difference in weight between the Austrian and British 12-inch projectiles is therefore no less than 160 pounds.

Bursting Charges.—Unfortunately there is no authoritative table which gives the weight and composition of the bursting charges of the above shells. It is believed, however, that Germany and Austria follow the same procedure in making the walls of the shell abnormally thick and filling with a very high explosive, thus assuring the dispersion of massy fragments at the moment of disruption. In contrast to this, the French, in their earlier mélinite shell at least, combined thin walls with an extremely heavy filling, the consequence being that the exploding projectiles literally pulverized themselves and blasted every light object in the vicinity. An effect not unlike this appears to have accompanied the famous Japanese "portmanteaux." Shells of this description cannot fail to be terribly deadly when directed against warships of the type much in vogue a few years before the coming of the *Dreadnought*, when very little armor was distributed anywhere save on the water-line. But their value has undergone a decline with the introduction of the standard all-big-gun ship, in which the main battle positions are so well protected as to be almost invulnerable to mere explosive assault. A big shell, as the French formerly conceived it, was the vehicle whereby a given quantity of explosive could be planted within an enemy's ship. To attain this object it was necessary that the projectile should be stout enough to withstand the impact at penetration, yet it was desirable not to exceed the minimum thickness required. The same ideal carried to an extreme strove to find expression in the dynamite gun, and it is evidently what the Japanese had in mind when they burst gun after gun in endeavoring to hurl highly sensitive explosives at battle range before the war with Russia.—*Naval and Military Record.*

GUNS FOR GERMAN NAVY.—The announcement is made that Messrs. Krupp have taken up the manufacture of three new types of heavy guns for the German Navy. The new types are stated to be 13.7-inch, 14.1-inch, and 15.1-inch respectively.—*Naval and Military Record.*

"LIFE" OF NAVAL GUNS.—A good deal has been heard about the durability and longevity of Krupp naval guns. It has been frequently stated that the "life" of a Krupp heavy gun is half as long again as that of a wire-wound weapon, and impressive figures have been quoted to support this contention, which it is important to Messrs. Krupp to establish if they are to maintain their present world-wide patronage. As is well known, the "life" of a rifled gun depends upon its caliber, or in other words upon the volume of the powder charge, the gases of which are responsible for the damage done to the rifling and the consequent loss of accuracy. According to well-authenticated German statements, the durability of the 11-inch B. L. (28 cm.) is 30 per cent greater than that of the 12-inch B. L. (30.5 cm.), a fact which may partly explain the original reluctance of the German authorities to abandon the smaller caliber weapon, and the persistent opposition of active naval officers to the proposed adoption of the 14-inch (35.6 cm.) B. L. Although no official data have been given out, the "life" of the Krupp 14-inch model is unofficially estimated at from 80 to 90 rounds. If this estimate is reliable, it would seem that the British 13.5-inch B. L., which in its improved state fires as heavy a shell as the German gun, viz., 1400 pounds, is quite equal in every way to the Essen product, as it is understood to be good for at least 80 or 90 full rounds without deterioration. In the important factor of weight, too, the British gun is said to have the advantage. The ballistics in both cases are a matter of surmise to the uninitiated, but judging from former models the muzzle velocity of the British gun should exceed that of the German.

Altogether it is fairly evident that the latest achievement of British ordnance makers need fear no comparison with the best German guns in regard to power, accuracy, or durability. It is admitted even in Germany that, except perhaps for the practically unknown Krupp 14-inch B. L., the British 50-caliber 12-inch weapon mounted in the later *Dreadnoughts*, is the masterpiece of naval artillery. This appears to be the opinion of all who have had any practical experience of the weapon in question.—*Naval and Military Record.*

IMPROVED LOADING APPARATUS.—If the present inspector of target practice closely follows the example set by his predecessor, we shall shortly be in possession not only of the results of the heavy and light gun-layers' test of last year, but likewise of that still more severe test of real gunnery efficiency, namely, battle practice. One of the most interesting points to attract the attention in this latter competition will be the rapidity of fire from the 12-inch guns. The service of ammunition from the magazines and shell-rooms to the primary guns of our battleships, is admittedly the best in the world. The old well that led from the turret to the shell-room at the bottom of the ship and supplied projectiles and charges by means of cages running the whole distance, has long since been abandoned by British designers, and only the large warships now relegated to the third and fourth divisions of the home fleet are fitted in this manner. In the later ships the service is cut in half, to the great advantage of rapid supply and safety, as an ample series of shot and shell and cordite charges is always on its way from the magazines and shell-rooms to the loading positions in the turrets, without there being any probability of a shell from an enemy's ship finding its way among them. In their later ships the Americans have likewise abandoned the old well system and introduced a service approximating closely to our own. What this service is capable of in expert hands with 12-inch guns, will be gathered from the rapidity of fire attained in last year's gunnery competitions in our own fleet, and a comparison can then be made with the rate of fire obtained on the *Orion's* gun trials with her 13.5-inch weapons. It is believed that there is little or no reduction in rapidity owing to the increased weight of the *Orion's* ammunition, which, it must be admitted, is a very satisfactory state of affairs, creditable alike to the designers and manipulators of the various machines used in loading operations.—*United Service Gazette.*

THE PROGRESS OF WAR MATERIAL IN 1911.—Trouble in Morocco, war in Tripoli, jealousy between Italy and Austria, and unrest in the Balkans, have combined to render the past year a busy one for manufacturers of war material. The greater powers, with the exception of Italy, had already completed their armament of quick-firing field guns, and have of late been turning their attention to field howitzers, mountain guns, and frontier defence guns. All the armies have been increasing their stocks of ammunition.

Field Guns.—No new field gun has appeared. The Deport "scissors trail" gun, already described in these columns, was tried in England in 1911, and did well. The Krupp semi-automatic field gun was described and illustrated in *The Engineer* of June 2, 1911. Italy requires some 600 field guns to replace the old semi-quick-firers, and is now holding competitive trials for their supply. Only two patterns of guns have been selected for trial, namely, the Schneider differential recoil field gun and the Deport gun mentioned above. A sum of two millions sterling has been sanctioned for re-armament. Incidentally it was stated officially that the price paid to Krupp's for a battery of six guns, 18 wagons, one tool wagon, and 7200 rounds was £22,000. Servia has ordered 160 quick-firing guns and 150,000 rounds of ammunition from Schneider's; these are presumably similar to the Schneider guns already supplied. The contract for the conversion of 100 of the old Servian 80-mm. guns was given to Ehrhardt's. Chili has ordered 200 field guns from Krupp's; the gun is a 14.3-pounder of the standard Krupp pattern, similar to the Italian gun. It is to fire both shrapnel and universal shell. Bolivia has purchased three batteries from Schneider's of the same pattern as the Spanish gun. China has ordered 18 field guns and 6000 rounds of ammunition from Skoda, of which 12 were delivered last year. The gun is a 14.3-pounder with Skoda wedge breech; it has the independent line of sight and traverses on the axle-tree. Small side shields are fitted to close the gaps between the main shield and wheels. The buffer has piston valves and no check buffer. On 4 feet 3-inch wheels, with 3-mm. shield, the weight in action is 18.5 cwt., and the weight limbered up with 32 rounds is 30.5 cwt. Spring limber hooks are fitted; there is an automatic fuse setter without differential corrector, and a portable observatory, to be mounted on the wagon, is supplied.

Horse Artillery.—The French are holding trials to select a gun to replace their present H. A. gun, which is too heavy. The ammunition is to be the same as that of the field gun, namely, a 15.85-pound shell with charge giving a velocity of 1730 foot-seconds, and the weight behind the team with 24 rounds is not to exceed 30.5 cwt. These conditions seem difficult to realize except with differential recoil.

Mountain Guns.—Trials are actively proceeding, but no large order has been executed. The type required for central Europe is a 14.3-pounder with M. V. about 1100 foot-seconds, capable of 45 degrees elevation, and fully shielded. This necessitates either the employment of a gun in two parts, artificially weighted as in the Schneider-Danglis pattern adopted by Russia and Greece, or else the differential recoil system. The former system is considered simpler and more practical. Thirty 12-pounder guns of this type were ordered by Turkey from Schneider's as the result of the competition held in 1910, and were delivered in the course of 1911. Bolivia has ordered a lighter pattern of this gun from the same firm, namely, a 12-pounder with M. V. 985 foot-seconds, weighing 10 cwt. in action and forming four loads without shield. Nine batteries are being supplied. Ecuador has purchased two mountain batteries from Ehrhardt's; this gun has controlled recoil, and is a 14.3-pounder, M. V. 900 foot-seconds, firing universal shell.

Howitzers.—The Germans have issued a new 4.2-inch quick-firing field howitzer, firing a 31-pound shell with pointed 4-caliber head, M. V. 985 foot-seconds. The shape of the head is a cubical parabola, which form is now superseding the ogive for field artillery projectiles. Only universal shell

are used. The howitzer is 14 calibers long, and the cradle has rear trunnions, with constant long recoil. It is sighted with the panorama telescope, and is fully shielded. The weight in action with 4-mm. shield is 22.5 cwt. The new Dutch howitzer is a similar weapon, but of only 3.75-inch caliber, firing a 22-pound shell and weighing 20 cwt. in action. The new Austrian howitzer is still in the experimental stage; it is of 4-inch caliber, firing a 32-pound shell with M. V. 985 foot-seconds up to 20 degrees and 1050 foot-seconds above that elevation. It is capable of 70 degrees of elevation. It has the independent line of sight, with range-drum graduated in meters for all six charges; it traverses on the axle-tree. With rear trunnions and constant long recoil, on 4-foot wheels, it weighs 23 cwt., but it is desired to reduce the weight to 20 cwt., and differential recoil is now being tried with this object in view. The Austrians recently mounted a 9.4-inch howitzer and carriage for transportation on three 100 horse-power Daimler motor wagons, so as to render it available with the field army. Servia has ordered 30 batteries of field howitzers from Schneider of Creusot.

Field Artillery Ammunition.—Combined shrapnel and high-explosive shell, now styled "universal shell," are coming into vogue since the introduction of this projectile for the new German howitzer, and all the leading makers have patterns of their own. Krupps use an axial high-explosive burster in the shrapnel, while Ehrhardt and Schneider put the burster in the head. Besides this, the shrapnel bullets are packed in trinitrotoluol, which detonates when the shell is burst with percussion fuse, but burns quietly when it is burst as a shrapnel in air. Modern field shell of this type contain about 45 per cent of bullets, three to four ounces of picric acid in the head or axial burster, and 4 ounces of T. N. T. among the bullets. Macarite, an explosive consisting of 28 parts T. N. T. and 72 parts nitrate of lead, has been introduced in Belgium for filling high-explosive shell.

Balloon Guns.—The Coventry Ordnance Works have produced a new balloon gun, and Krupp, Ehrhardt, Schneider, and Skoda have all supplied a few experimental guns. These are all high-velocity 12-pounders, mounted on motor wagons, and firing smoke-trail shell with sensitive fuses. They are of little use against aeroplanes, and the authorities are waiting to see whether military dirigibles will be introduced on any extensive scale before ordering guns for their destruction.

Small Arms.—The great powers are delaying the issue of automatic rifles, since if any army were to introduce a new rifle its neighbor would immediately produce another and possibly a better one. The only new automatic rifle issued in 1911 was the Genovesi-Revelli, of which 6000 were manufactured at Terni, Italy, for the Bersaglieri cyclists. The Austrians have a new ranging bullet for infantry, which is exploded on impact by a cap. It is stated that the strikes of a half-section volley are visible at 1200 yards. Experiments are being conducted with rifle grenades weighing about 2 pounds, fixed to a rod loaded into the muzzle of the rifle, but these have not at present been adopted as a service projectile. Machine guns are still being manufactured in large numbers to complete the armaments of the principal powers, the favorite patterns being the Maxim, Hotchkiss, and Schwarzlose. Automatic pistols are replacing revolvers in all armies except our own. There is a tendency to evade the difficulty of combining an efficient man-stopping bullet with slight recoil by the use of a large-caliber aluminium bullet; thus the Schonboë pistol is of .450 caliber and fires a 63-grain aluminium bullet with a velocity of 1470 foot-seconds. The high velocity gives great accuracy at short ranges, while the recoil is very slight.

Fortifications.—Italy and Austria are still busy fortifying their coasts and frontiers against each other. The Italians are constructing powerful defences on the Adriatic coast, to be armed with 12-inch guns and 12-inch howitzers. Six 40-caliber 12-inch wire-wound guns have been ordered from Armstrong's at Pozzuoli for the defences of Venice, and the new 15-

inch gun is spoken of for the Brindisi forts. On the land frontier, both sides are mounting 6-inch and smaller guns; Skoda has an order for 50 steel cupolas for machine guns and small quick-firers. These are 8 inches thick, cast in one piece, and weighing 13 to 20 tons. The same firm is turning out revolving turrets for 4-inch howitzers firing up to 70 degrees elevation, and for muzzle-pivoted 6-inch guns. Chili is making Iquique into a first-class fortified harbor armed with Krupp guns, and is building defences at Arica and Tacna. The Turkish Government, in January, 1911, decided to spend a large sum on coast defences, including £75,000 for the armament of Tripoli, but nothing was done till too late.

Air Craft.—The numerous accidents to the great dirigibles have, to some extent, encouraged the construction of miniature dirigibles, which are cheaper and handier than the unwieldly Zeppelins and Parsevals. Thus the Villehad-Forsmann dirigible is of only 800 meters capacity, weighing under 9 cwt. It is non-rigid, with one ballonet, and has a 24 horse-power engine coupled direct to the propeller. It is stated to have attained a speed of 25 miles an hour, but even this would limit its employment to light breezes. On the other hand, the German military dirigible *L. Z. 9*, launched in October, 1911, is a large airship with three motors, capable of 48 miles an hour. Aeroplanes are now being built with more regard for stability and less for speed. Thus the Lohner-Daimler biplane, adopted by the Austrian Army, has the upper plane curved sharply backwards at the ends like the wings of a swallow, while the area of the lower plane is only one-third of that of the upper plane. This construction is said to give great stability in rough weather. With 70 horse-power engine and 9-foot propeller, this plane has a speed of 43 miles an hour. A new projectile for use from aeroplanes and dirigibles is a torpedo-shaped bullet weighing one ounce, intended to be simply dropped on troops below. Owing to its shape this bullet acquires sufficient velocity to kill a man when dropped from a height of 2400 feet. Since a military dirigible of the *L. Z. 9* type can carry some 16,000 of these bullets as ballast, she would be capable of causing considerable annoyance to the enemy's troops.

Searchlights.—The Russian Army has taken the lead in providing means of illumination for troops engaged in night operations. Five hundred motor projectors are being issued to infantry regiments and staffs, and considerably more will be required before the whole army is equipped.

Telegraphy and Telephony.—The Bellini-Tosi system of directive wireless, described in *The Engineer* of January 7, 1911, has been improved by the addition of a second crossed aerial. There are now seven fixed coils and one directive coil, and it is stated that the loss of power which constituted the defect of the original apparatus has been almost entirely overcome. Major Squire, of the U. S. Signal Corps, has invented a multiple field telephone which enables ten stations to use the same cable. Field telephones have been issued on a large scale in the French, German and Italian Armies.

Mechanical Transport.—For ordinary war transport the authorities rely upon the motor vans and lorries in use in the country. But a demand for special fast transport vehicles has recently arisen. The Italians have converted their rifle regiments into cyclists, and are now holding trials to select a pattern of fast 2-ton lorry to form the transport of this corps. The French are organizing mobile frontier forces consisting of large bodies of cavalry and cyclists, and about 400 light motor wagons will be required, since these forces are to keep up their transport complete in peace time.—*The Engineer.*

THE SELF-SCORING RIFLE TARGET.—Invented by Lieut.-Commander M. St. C. Ellis, U. S. N.—The mechanism is exceedingly simple, consisting of a number of designating plates made of special treatment Vanadium steel, cut to the size and shape of the target. These plates are guaranteed to stand the impact of the new Springfield bullet indefinitely. It was found that the unhardened steel plate, one inch thick, would not withstand the

new Springfield bullet; whereas this special plate, of only half that thickness, will endure the impact indefinitely.

These designating plates are suspended from a central holding spindle by steel radial springs. Back of the designating plates and protected thereby is a steel shuttle board which holds the contact-making members. The action of the target when struck by the bullet is as follows: The plate which is hit yields slightly against its springs, thus taking up the powerful blow, while the contact-making shuttle, which normally touches the rear of the plate, flies backward against the tension of a weak spiral spring and completes the electric circuit, making a prolonged contact. The electric circuit thus completed, passes through appropriate cables and actuates an annunciator made up as a replica of the target itself; this annunciator is set in close proximity to the firer. Each designating plate on the target has its corresponding section on the annunciator. When a particular plate is struck a white drop with a black number falls into a hole in the corresponding section at the firing line. The man who is firing can thus tell, even before the report of the impact of his bullet reaches him, where it has struck the target. An electric set-back returns the drop to its original position at the will of the operator and the target is thus ready for the next shot. A battery of 24 volts furnishes the electricity.

The target is portable and does away with pits, tunneling and expensive range construction. Even waste land can be used for range, making it possible for small organizations to own a target and rent the land for stated periods. In fact it can be transported from one town to another, and several companies can thus use the same target, or a man-of-war can carry the targets on board and set them up on shore in a short time for practice, thus obviating the necessity for visiting a regular target range.

As there are no men employed as markers, all danger is eliminated, and persons who like to shoot can go out alone or in small groups outside of working hours and enjoy small-arms practice. One can shoot alone as well as with a squad and all that is necessary to do is to throw in the switch and go ahead. There is nothing about the mechanism that can get out of order. All the working parts are completely incased in a sheet-iron housing making it necessary to have only a covered firing point to use it in all kinds of weather. If desired, a screen may be placed in front of and out of the spatter zone of the target.

During the past nine months a target of this type has been in constant service at the Mare Island Navy Yard, San Francisco, where it has shown such good results that it has been ordered purchased by the Navy Department. A duplicate of the target has been hit over 200,000 times with the new Springfield rifle, the striking energy of whose bullet at 200 yards is 1678 foot-pounds. This is a pretty severe test, and it is interesting to note that the target shows today no signs of deterioration.

As regards the effect of quick reading of results in popularizing rifle practice, we note that a divisional officer from one of the ships on the Pacific coast has stated that the marksmen whom he took to the range for rifle practice were keen to fire at the target, when not otherwise employed, with the result that, during the three days this division was on the range, the target was in constant use.—*Scientific American.*

FRENCH NAVAL AMMUNITION.—M. Painlevé, reporter on the French Estimates for 1912, expresses the view that there is no reason for changing the character of the powder supplied to the navy. He would prefer the now notorious B powder to the powerful progressive explosive of the Germans. He thinks that all that is required is to have the B powder homogeneous and carefully prepared. Foreign critics, he believes, are of this opinion. This powder is at least equal to nitroglycerine powders, but who has sufficient authority to lay down the rules of manufacture or give confidence to seamen? Who is to fix the period of stability for the

powder? He says there must be no mixing of powders whose age differs more than three months. The condition of manufacture must be established, and the services must be secured of eminent chemists, who have been trained in the laboratory of the polytechnic school. M. Painlevé thinks the navy should have a factory for guncotton and two for the existing powders. The history of the powders, not only from Pont-du-Buis, but from other factories, must be carefully scrutinized. The navy must exercise a permanent control over the manufacture, and the new arrangements on this head can only be regarded as a step in the right direction. M. Painlevé also makes some comments on the system of storing ammunition.—*Army and Navy Gazette.*

This corresponds to the general view of American chemists and powder manufacturers. Nothing is wrong with the French powder, it is simply not made properly.

SHIPS' MAGAZINES. *Precautions for their Safety.* (By an expert).—With the disaster to the *Liberté* still fresh in our minds, it may not be amiss to discuss the important question of how magazines should be treated, with the view of eliminating all possibility of any similar occurrence. As the present writer understands the matter, the disaster which occurred on board the *Liberté*, and that which occurred on board the *Jéna* some years ago, where both due to two causes, the nature of the powder which is employed in French men-of-war, and the failure to efficiently arrange the conditions in the magazines in which the powder was stored to provide against the peculiar action to which such powder is subject. The occurrence of the explosion on board the *Liberté*, following that of the *Jéna*, naturally led many of those who have studied the subject, to think that the explosion on board the United States ship *Maine*, which it will be remembered led almost directly to the Spanish-American War, might also have been caused in the same way. The report of the experts who investigated the question nullifies this supposition. According to the report, although the principal damage which was done to the *Maine* was due to the explosion of her own magazines, the primary cause was the explosion of a bomb or a charge of some kind under her bottom. The heat caused by this explosion led to the later explosion of the own magazines, and the question may therefore arise whether the use of similar powder in the American Navy as in the French Navy did not amount to what lawyers call a contributory cause. At the present time, as the writer understands, only France, Russia, and the United States use the particular powder which is believed to have caused the disaster on board the *Liberté*, in their navies. As he understands the matter, the powders used in the French and other navies mentioned differ in their properties from that used in the navies of the United Kingdom, Germany, Japan, and Italy to a very important extent. The powder used in the French and American Navies has the great advantage that it has not such a great erosive effect upon the gun barrels as the powder used by Great Britain and the other powers named. This is undoubtedly an important advantage, in view of the increasing size of the guns mounted by the modern battleship and of their increasing cost. It is not only that the life of the gun is shorter with the powder used in the British Navy, and therefore the gun must either be relined or replaced after a certain limited period, but in case of war the limit of its useful life might have an important bearing upon the fate of a war, and even upon the fate of a particular action. Hence the use of the less erosive powder by the United States Navy. In both powders an attempt has been made to place as high an explosive power as possible within as small a compass as possible, consistent with the whole of the explosive power being brought into operation within the time that is available for the burning of the charge.

Complete Combustion.—One of the problems with which artillerists have been faced since the advent of rifled guns, with their greater accuracy, higher muzzle energy, and the increased energy required to be expended

upon the shot or shell before it leaves the mouth of the gun, has been the complete combustion of the charge. In the old smooth-bore gun, as in so many other machines of the old days, no effort at accuracy or economy of powder was made. The one thing aimed at was to force the spherical mass out through the gun at as high a speed as could be managed under all the conditions. With the modern gun all that has been altered. The space that can be allotted to the powder charge is strictly limited, the time during which the charge is exerting its power is also strictly limited, and the problem involved in utilizing the power to the fullest extent is by no means an easy one. The powder charge in a gun and the charge of gas and air in a gas engine are very much alike. The action is almost the same in the two cases. The piston of the gas engine corresponds to the shot or shell in the case of the gun. In both cases the force exerted upon the piston or upon the shot or shell is due to the heat liberated by the burning of the charge, and the consequent instantaneous expansion of the products of combustion. The more quickly the charge can be burnt, the more rapid is the development of heat, and the greater and more rapid is the expansion of the gaseous products formed by the combustion of the charge. But in both cases, if the combustion goes on at more than a certain speed, the whole of the charge cannot be burnt. In the gas engine and in the gun the object to be moved, the piston and the shot or shell, commences its motion almost immediately the charge is fired; and, therefore, unless the ignition can penetrate to every part of the charge before the shot or shell has moved a certain distance in the case of the gun, and before the exhaust valve opens in the case of the gas engine, a portion of the charge may be blown out unburnt.

Modern Powders.—On the other hand, it is of great importance that the pressure behind the shot or shell in each particular case shall be as uniform as possible. That is to say, good shooting, accurate shooting, and large percentages of hits require that the force with which the projectile is ejected from the gun, and the manner in which the force is applied to the projectile, shall be as uniform as possible under any given conditions. It has been proved that all smokeless powders, which include practically all powders now used in the navies of the world, increase the pressure which they developed when fired in the gun if they have been exposed to a temperature above a certain figure. For the powders used in the British Navy a temperature of 20 degrees Centigrade, corresponding to 68 degrees Fahrenheit, is the limit. All powders of the modern kind, into which nitroglycerine enters, have the property that is common to a great many chemical compounds and chemical mixtures—that almost from the moment of their being made up decomposition commences, with a certain generation of gas. It is a peculiarity of nearly all chemical compounds which behave in this way that the decomposition and the delivery of gas increase very rapidly with increase of temperature. The powders used in the British Navy have the great advantage that they do not require to be hermetically sealed, while the powders used in the French and American and Russian Navies do. Hence it follows that with powders in which nitro-cellulose is the principal ingredient, if they are exposed to temperatures above those mentioned, gas is liberated freely within the sealed packages containing the powder. The continued liberation of gas is very much like the continued generation of steam in a steam boiler. If it continues, and there is no safety valve, a time arrives when the pressure set up by the gas bursts the case in which the powder is enclosed. In addition to this, the compression of any gas, however produced, raises its temperature, and in the case of the gases liberated by the decomposition of the powder, the time at which the case is burst may coincide with the time at which the heat present is sufficient to ignite the gases themselves. In any case, if ignition takes place before the case is burst, a greatly increased generation of gas results, followed immediately by the bursting of the case and the liberation within the magazine of a considerable quantity of heated gases. Bearing in mind that there will usually be a

quantity of other explosive in a state of strain, at least in the magazine, the result which followed in the case of the *Liberté*, the *Jéna*, and in the *Maine* is practically a natural sequence.

Influences on Temperature.—Now, as to the conditions under which magazines have to do their work, to hold their charges of explosives harmless. Magazines are necessarily placed low down in the ship to be out of the way of shell. Necessarily also they are connected with the turrets or barbettes they are supplying by masses of iron. They are also enclosed by masses of iron. The whole ship is a mass of iron. The ship, when under way, is propelled by steam generated in boilers, and consequently a considerable amount of heat is liberated there, apart from that employed in raising steam, and the conducting mass of metal of which the ship is composed carries the heat in all directions, and amongst others to the wall of the magazine. Further, when firing takes place, a considerable quantity of heat is liberated within the turrets and barbettes, and this is conducted directly to the magazines below. The result is, naturally, that the temperature rises within the magazines, and if powder is carried which is obliged to be hermetically sealed, and no means are taken to neutralize the rise of temperature, the decomposition and generation of gas described above goes on continuously, and the disastrous results that have become only too familiar follow.

How Magazines should be Treated.—The magazines of most navies, the writer believes, are already treated by the circulation of air that has been cooled continuously passing through them. He would suggest that it would be possible to lessen the work which the air has to do, and to increase the safety of the magazine by insulating it thermally wherever it is possible. There are a number of thermal insulators employed by refrigeration engineers to line cold chambers on the inside. The problem involved in keeping a cold chamber cool is exactly the same as that involved in keeping a magazine cool. Heat may be prevented from entering the magazine, and any heat which does enter may be carried away. There will be difficulties in the way of thermally insulating a magazine in the same manner as a cold chamber designed to preserve produce is insulated, but a good deal may be done. As with electricity, there is always the difficulty of providing efficient insulation, because the thermal insulators are mechanically weak. Some of those that have recently been put upon the market, compressed cork for instance, are very much stronger and more easily applied than the earlier forms, with which wood casings had to be built and the insulators filled in loosely and rammed down. Compressed cork, the writer believes, could be applied to line the walls of magazines, so that there would be no direct transference of heat in that direction; the roof and floor could also be lined, and it would be possible, he believes, by careful design, to work in insulators, so as to reduce the amount of heat transmitted even from the turrets.

For cooling the magazines, after all that is possible has been done in the way of insulating them, the cold air system already in use could hardly be improved upon. The use of cold dry air is the latest development employed by refrigeration engineers. It has the important advantage that it clears all moisture out of the room it is employed to cool, and this will be of great value in the case of magazines, and particularly with the powder used in the British, German, and other navies. Moisture plays an important part in the decomposition of the powders referred to above. With the powder used in the British Navy, hermetically sealing is not necessary, and therefore the passage of a current of cold dry air over the surfaces of the packages containing the powder will carry off any moisture that is liberated and keep the powder dry. The old saying, "keep your powder dry," is as important today as it was in the Napoleonic wars.

Cooling air by passing it over a grid of pipes in which either cold brine or carbonic acid gas is present also dries it. The capacity of air for holding moisture increases with its temperature, and consequently if the temperature is lowered the ability to hold moisture is also lowered, and the

moisture is deposited upon any cold surface that is present, and the air passes on dry. It appears to the writer that the cooling air might be carried with advantage below the figure that rules in the British Navy.—*Naval and Military Record.*

THE INFLAMMABILITY OF CELLULOID.—It is well known that celluloid is highly inflammable and on various occasions has caused loss of life and property. The chemical process of its combustion has recently been studied by Dr. Panzer, of Vienna, and the results of his experiments are of great value to science and industry; as they show a way of dealing with a celluloid blaze. This substance does not ignite spontaneously; but it was found that after extinguishing the flames of a piece of burning celluloid, decomposition would still go on, and would continue even in a vessel filled with carbonic acid or steam. This shows that atmospheric oxygen is not necessary for decomposition; that a fire caused by celluloid can only with difficulty be put out with water, and that ordinary chemical fire extinguishers are useless. The flameless combustion starts at a temperature of but little over 100 degrees Cent. (212 degrees Fahr.) so that the decomposition may be started by a flame situated quite some distance away. The white vapors resulting from the combustion form an explosive mixture with air. To extinguish a celluloid blaze in a building is a most difficult task, if not impossible. On account of the rapidly spreading flames and the excessive heat of the fumes (nearly 750 degrees Fahr.) the seat of the blaze is almost inaccessible to the fire fighters. Ignition and gasification of celluloid may be caused by an open flame or simply by heat. The temperature required for decomposition lies between 105 to 185 degrees Cent. (221 to 365 degrees Fahr.), therefore a hot stove can cause the decomposition. If a piece of celluloid is slowly heated, it may be observed that it softens at first, then blisters begin to appear all over and suddenly decomposition sets in, sometimes accompanied by flames. The products of dissociation consist of gases, liquids and carbonaceous matter. The colorless gases contain carbon monoxide and nitrogen oxides and are therefore extremely poisonous.—*Chemiker Zeitung.*

DISCUSSION OF THE "LIBERTÉ" IN THE FRENCH CHAMBER.—The official *Liberté* inquiry was conducted by a board of line and staff officers headed by Rear-Admiral Gaschard, a highly thought-of officer, whose name alone was a guarantee of wisdom and impartiality.

This board's report was awaited with great anxiety. It was remarkable for its moderate tone and clearness, showed the efforts made in search of the truth, and concluded that the cause was the spontaneous burning of a cartridge of B powder in one of the forward two starboard 19 cm. magazines.

In the Chamber, all the speakers, with the exception of M. Painlevé, have accepted this. Although he considers this cause quite probable, yet he still is in doubt, and refuses to attribute only to the powders alone the responsibility of the disaster. "You know," he states, "that this is the conclusion of the board of inquiry, and I must say that, without feeling certain, I consider this explanation as the most reasonable." M. Painlevé is by no means certain that a fire had not started from some other cause in the 19 cm. magazines. "Everyone recalls," he states, "the value of the witnesses at the inquiry, I am not very sure that it is necessary to deviate from the unlikely theory according to which the beginning of the fire started in magazine of 47 mm. and 65 mm. which contained the oldest ammunition, put up in 1898."

We will consider, as well grounded, the doubt expressed by M. Painlevé on the particular magazine which might have been the starting point of the accident.

The verdict of the board rests on a lone witness, that of a sailor who was on the upper deck, and who heard three successive explosions, separated by an appreciable interval: "There are three cartridges of the

same pile which have successively exploded," concludes the board, but this finding is not certain.

But the question of knowing in what condition the decomposing powder grains would have to be to ignite was made the object, in 1907, at the laboratory central of Poudres et Salpêtres, of experiments which led to conclusion that a proportion of decomposing grains in the charge would not imply the danger of ignition, and that it would be necessary to have decomposition in bulk, as in the experiments at Versailles, to place the powder in the condition for spontaneous ignition.

These experiments tended to prove that the presence of some decomposing grains in the magazines which burned the *Liberté* would not be a serious presumption in favor of the hypothesis of a spontaneous ignition.

M. Chautemps knows well that the powders have been made without any care; but he believes in other causes of the disaster.

We would not have had the disaster of the *Liberté* if the suspected magazines had not contained all the right elements for making a huge fire follow an explosion of 50 seconds of the powder B; it is a big fire, a fire of wood, and of paints, which in 19 minutes caused the explosion of the shells.

In the Chamber, M. André Lefèvre, whose remarks are always well considered and in perfect good reason, has held the theory that our war powder well made is good, but that, like all powders in the world, it demands careful watching; the *powder B*, of which he accepts the spontaneous ignition, *has been*, in the explosion of *Liberté; only the match setting the fire to the woodwork and the paints;* the flames of the powder would have been powerless, because of their short duration and of the mass of shells, to bring them to the temperature of the explosion of definite, but they lighted a big fire, a fire of wood and of paint, in which the shells have grown hot, following the words of M. Lefèvre, during 20 minutes, and thus the shells exploded.

The shells are the only real dangerous element to the safety of the vessel. *A magazine ought not to contain wood, paint or shells.*

. . . The experiments at Gavres showed the need for the separation of the shells, of the exclusion of all combustible matter, of the installation of instantaneous flooding apparatus, maintained constantly under pressure, and an automatic starting device! We know that the disposal of the primers or of ignition charges installed in the cartridges and the tanks render more and more probable the extending of the fire from one cartridge to the next! And we keep, nevertheless, in the powder magazines, wood, paint and shells! The flooding under pressure, the flooding automatic were not even studied! We are *now* studying them!

The true responsibility lies in the conditions, and it is not only against the spontaneous combustion that precautions ought to be taken; the most stable powder would be exploded by awkward handling of the cases, fall, or friction, or by secondary causes of which we have seen so many examples, as the neighborhood of a warm bunker. It is unfortunately not illogical to think longer of malevolence.

When the necessary precautions have been taken against the consequences of a sudden ignition and against the existence of faulty ammunition, our sailors will be able to have an absolute trust in the worth and the security of the fighting implements placed at their disposal.—Translated and abbreviated by the Editor from *Le Moniteur de la Flotte.*

The necessity for removal of wood and paint from our magazines is here again emphasized.

RESULT OF "LIBERTÉ" COURT-MARTIAL.—The court-martial, presided over by Admiral Jauréguiberry, has exonerated from all blame the officers of the battleship *Liberté*, in connection with the recent disaster.

Captain Jaures was relieved of responsibility because of his absence from the ship on leave at the time, and the court-martial not only acquitted Lieutenants Garnier and Bignon, but warmly congratulated them on their behavior at the time of the accident.

Lieutenant Garnier was temporarily in command of the *Liberté* at the time of the explosion, which resulted in the death of 235 men and serious injury to nearly 100.—*The Navy.*

ARMORED SHIPS OF NOT?—A correspondent suggests that even as the use of gunpowder in warfare led to the abandonment of suits of armor as a protection to the caparisoned warriors of old, the all-big-gun idea in battleships may soon lead to the abandonment of the custom to protect the vital parts of ships of the line with armor plating. The analogy is by no means as irrelevant as it may appear at first glance and deserves more than passing notice, being based upon the superiority of the gun over the armor plate. From the time of the epoch-making armored French batteries engaged at Kinburn down to the present day a bitter duel has been fought between the gun and the armor plate. Sometimes the armor plate has won, but always the gun has regained the mastery; and this mastery over the armor plate obtains today, with the additional factor that for its given weight something like finality has been reached in armor plate resistance and the big guns of today shoot through this finality with ease. The 13.5-inch gun mounted on the *King George V* class of British battleships throws a projectile of 1250 pounds in weight which will pierce 14.4-inch of Krupp cemented armor plate at 7700 yards. At 5400 yards, the same shell will pierce 16.3-inch of Krupp plate. The 1582-pound missile of a 14-inch gun will pierce 15.6-inch of Krupp plate at 7700 yards and 17.3-inch at 5400 yards. The 1950-pound shell of a 15-inch gun would go through 17.2-inch of plate at 7700 yards and through 18.9-inch at 5400 yards, while a 16-inch weapon firing a 2367-pound shell would penetrate 20.5-inch of armor plate at 5400 yards and 18.8-inch at 7700 yards. Of course, armor will keep out the shells of the secondary battery, but at the ranges contemplated for future warfare, outside of anti-torpedo protection the secondary armament need not be taken into consideration. At the rate of one hit per minute, which may be confidently expected of well-trained gunners, it is inconceivable that any amount of armor on a battleship could resist the terrific impact of a succession of shells fired by a ship mounting, say, ten 14-inch guns. Outside of the economical advantage in discarding the costly armor protection, how could an unarmored ship of the line be built with offensive power superior to that of the armor-plated ships? Simply by utilizing the 5000 tons of weight and the two and a half million dollars thus saved to increase the speed and double the number of the guns. Imagine a battleship with a speed of 40 knots and armed with twenty 16-inch guns firing projectiles weighing about a ton apiece. Such a ship could destroy a squadron of present-day battleships by reason of the terrible smashing power of its guns and its ability to choose its own range and outsteam and outmaneuver its opponents.—*Shipping*, Illustrated.

MARINE ENGINEERING.

MARINE INTERNAL COMBUSTION ENGINES.—The events of the past year all go to show what a keen interest has now been aroused, among technical men at all events, in the question of the application of the internal combustion engine to ship propulsion. Nearly every scientific institution which could by any means consider the subject as within the scope of its proceedings has had a paper dealing with some phase of the question. This may be taken as only a straw which shows the way the wind is blowing but another quite unmistakable indication lies in the great number of important marine engine building firms which it now appears have taken, or are contemplating taking out licenses to build marine engines of the Diesel type. There is, on the other hand, very little in volume—though much in interest—that can be said as to what has actually been accomplished in this direction in this country at all events; though, as we suggest, there is plenty upon which we can build hopes for the future, and

many of these proposals should come to fruition in the early part of this year, when we shall deal with them as they deserve.

Long Voyages.—The most practical event of the year in this connection was, to our mind, the putting into service of Diesel-engined tank ship *Vulcanus*, built by the Nederlandsche Fabriek of Amsterdam for the Nederlandsche Indische Tankstoomboot Maatschaapij. This boat, which we described fully in January, is, it will be remembered, of 1900 tons displacement, with a carrying capacity of 1000 tons, and is fitted with a 500 horse-power six-cylinder four-cycle Diesel engine, built by the Nederlandsche Fabriek. After some six months' work in short coasting trips to gain experience and confidence, she made a 19-day run to Constanza, a distance of just over 3300 miles, on a consumption of 2.15 tons of oil per 24 hours at a speed of about 7¼ knots. So successful has she proved that a pair of ships of double the horse-power are now under construction for the same owners by the same builders. A bigger but less powerfully engined boat is the *Toiler*, built by Swan, Hunter and Wigham Richardson, Limited, with a carrying capacity of 2500 tons, and fitted with twin-screw engines of 350 combined horse-power of the two-cycle type, built by the Swedish Diesel Motor Company, of Stockholm. This boat again was kept to short trips for some months, but in the autumn took to herself an historic interest by crossing the Atlantic, and is, we understand, now giving satisfaction in regular service on inland waterways. A third full-powered Diesel-engined ship is the Italian *Romagna*, which was put on to the *Trieste, Ravenna* and *Fiume* service late in the summer, but was unfortunately lost in one of the November gales. This combined passenger and cargo ship was fitted with two sets of 400 horse-power Sulzer-Diesel engines, which gave her a speed of 12¼ knots, and she was described in our issue of December 22. The result of the inquiry which is now being held as to the cause of her loss will be awaited with much interest, though from what we hear we do not gather that it was in any way due to failure in the engine-room department, and we should not be surprised to hear that it was entirely a question of ship and cargo. Whatever the cause, her loss is greatly to be regretted, as it is sure to give occasion for the opponents of the internal combustion engine to decry this form of motive power; but what is of infinitely more importance, the opportunity of gaining valuable experience, which is so particularly necessary just now, has been lost.

Auxiliary Engines.—Another important application of Diesel engines was to the four-masted ship *Quevilly*, constructed for French owners, and fitted with two sets of 300 horse-power M. A. N. engines as auxiliaries. This ship is of about 6000 tons displacement, and will undoubtedly be the forerunner of many others of the type; the Diesel engine is so peculiarly suitable as an auxiliary even today, saving towage charges, defeating calms, and having no stand-by losses, while its want of proved reliability is, for this purpose, no disability, as even if deranged for any reason, the safety of the ship is not necessarily imperilled thereby.

Suction Gas Engines.—The use of suction gas appears to have made less progress than was at one time expected, the leading example built during the year being the *Holzapfel I*, a ship of 290 tons gross register, built by Eltringham, of South Shields, for the Holzapfel Syndicate. She is fitted with a set of six-cylinder 180 horse-power gas engines, by E. S. Hindley & Co., of Bourton, which transmit their power at 450 revolutions per minute through a Föttinger hydraulic power transformer to the propeller, which runs at a more reasonable number of revolutions. The gas-producing plant was supplied by the Power Gas Corporation, of Stockton-on-Tees. The ship has made a number of coasting voyages, carrying coal, iron, etc., the consumption varying from 25 cwt. to 33 cwt. of coal for the 24 hours. As we have not had an opportunity of making a trip in this boat, we are unable to say how far the difficulties in connection with the variations in the demand on the producer have been met. The only other practical example of the use of suction gas which we have come across

during the year was the *Progress*, an old service boat, fitted with a three-cylinder double-acting two-cycle gas engine, designed by Mr. C. H. T. Alston, which we described last May. We expressed admiration for this engine, particularly for the closeness with which it followed ordinary steam-engine practice, for the compressed air governing arrangement, and the simplicity of the reversing arrangement, which was by a single lever. As we said then, it was only experimental, and the results of the experience gained with it have not yet been embodied in the new engine; but this we shall hope to deal with later. Two or three small installations of suction gas have, however, been carried out in the United States. For instance, the *Mary A. Sharp*, of 66 feet in length, has been in regular service in Chesapeake Bay; she is fitted with a three-cylinder 75 brake horse-power two-cycle engine; with a compression pressure which is claimed to be 135 pounds per square inch; a mean effective pressure of 56.2 pounds has been obtained at 300 revolutions per minute, the consumption of coal being about 1.3 pound per indicated horse-power per hour; the total weight of the plant is said to be 205 pounds per brake horse-power.

Work in Hand.—With regard to continental marine work generally, apart from the *Quevilly*, the *Romagna*, and innumerable submarine engines which have been built for the French, German, Italian and other governments, there is not a great deal to report as to actual results, though, as will have been gathered from our series of articles in December, an enormous amount of work is in progress, such as the *Woermann* liner, which is to have twin-screw, double-acting engines of 2400 combined horse-power, one set built by the M. A. N., and the other by Messrs. Blohm & Voss; the Hamburg-South American liner, which is having her twin-screw machinery built by Sulzer; *La France*, a huge sailing ship, which is having auxiliary engines built by Schneider's; the oil-tank 1100 horse-power ships being engined by the Nederlandsche Fabriek; the *Selandia* and her sisters, to have twin-screw Burmeister & Wain engines of 1250 horse-power each, for the East Asiatic Oil Company; and the twin-screw 4000-ton oil tankers for the German Petroleum Company, which are to have engines of 750 horse-power each, built by Frerich & Co. under license from Professor Junker, and two 9400-ton ships under construction by the same builders with 3300 combined horse-power Junker engines. Truly a good list, though admittedly very incomplete, but it should make a busy year. In this country interest will be centered on the 800 horse-power four-cylinder two-cycle Carels-Westgarth engine under construction by Richardsons, Westgarth & Co. for a 3000-ton capacity ship, and the eight-cylinder sets of four-cycle 2500 combined horse-power engines being built by Barclay, Curle & Co. Something definite should also shortly be known as to the Diesel-turbine combination which is on order for destroyer purposes at Thornycroft's. Nothing will probably be known for some time as to what Vickers are doing on a large scale for cruiser work, nor are we likely to have details as to the submarine Diesel engines which they are turning out, but much has been and is being done in this direction, details of which we are content not to endeavor to make capital out of.

The Line of Progress.—So much for history and anticipations; let us see what tendencies are indicated by, and what conclusions can be drawn from, such knowledge as has been made public. Experience has, to our mind, clearly proved that, as was only to be expected, the internal combustion engine has not yet reached the point of equivalent reliability with steam; little derangements have occurred and are to be expected to occur for some time yet, which only emphasize the demand for the utmost accessibility of all parts, and the wisdom of the policy of fitting twin-screws in all open-sea craft. This latter point, also for the present, assists in meeting the difficulty as to the smallness of the power units which have reached a commercial basis. As regards the economy or otherwise of the internal combustion engine as compared with that of the steam engine, we must admit that up to the present we have seen no figures which can be considered in any way conclusive one way or the other, though many

have been published, all, or nearly all, based not upon experience, but upon estimates, in which the personal element is bound to have an undue influence, as is indicated by the fact that both forms of power have been proved to the satisfaction of their supporters to be the most economical. Reliable figures in this connection should, however, be obtained when the *Furness* boat which Richardsons, Westgarth & Co. are engining has been at work for some time, as she is similar to a number of other ships fitted with steam machinery belonging to the same firm, and will run on exactly the same service, so that the comparison will be an exactly fair one as far as running costs are concerned, and a figure will be obtained for cost of carriage per ton per mile, which is the conclusive figure. Even thus, however, the capital charges will not be entirely satisfactory, as the first cost of the Diesel engine is bound for the present to be very much higher than will be the case when more experience has been gained in its construction. Maintenance and fuel charges, too, are likely to decrease considerably for the Diesel engine as time goes on, and further improvements are introduced, while steam is getting nearer the end of its tether in this direction.

As to the use of the two-cycle or the four-cycle engine, we do not think it is fair to say that the advantage has been proved to lie definitely with one or the other, though the majority of builders apparently prefer the two-cycle—largely, no doubt, on account of the lower cost per horse-power and the larger powers which can be built with present-day knowledge of the heat difficulties. As to general features of design, the consensus of opinion among builders is almost unanimous in favor of the crosshead type of engine rather than the trunk piston, except for naval purposes, where weight and lack of head room call for the latter. How far this is due to the recognition of the prejudice which undoubtedly exists among sea-going engineers in favor of what they are accustomed to, it is hard to say, but it is hardly likely that mere sentiment would be allowed to exert a great influence in a direction which leads to a considerably more expensive, heavier and higher type of engine, and we are of opinion that the arguments used by Mr. J. T. Milton in his paper before the Institution of Naval Architects last spring are sound, and are the real determining factors; at the same time, as we have said on other occasions, we think that these prejudices are worthy of the closest consideration.

Reversing and Transmitting.—With regard to reversing, we think that where it is decided that the best method of going astern is that the engine itself shall be capable of being started and run in either direction, compressed air has proved itself not to be open to serious defects to the extent at one time feared; in fact, from our own observations of numerous cases, although made only under trial trip conditions, it would certainly appear very fairly to meet the requirements of the case. Again, however, it can hardly be said as yet that it has been definitely proved that a reversing engine is the best method of going astern if the intermediate stages—that is, the slow and very slow speeds—are also considered as a part of the problem. Certain it is, that this is a factor which calls for very early and very careful attention at the present moment; it has by no means been satisfactorily solved. Various transmission systems, such as the Föttinger, Hele-Shaw, and Manly Hydraulic, the Mavor and Coulson, and Durtnall electric, and others, have been suggested and submitted in some degree to practical tests. They are designed, of course, to give not only the reverse, but any intermediate speed from maximum to zero, while the engine continues to run at an efficient speed. Such tests as have been made, however, have not been so arranged as to give full scope to the possibilities presented, which allow of the motive power being divided into a number of separate units, all delivering into the transmitter or transformer, and each of these units being run at all times at approximately its maximum efficiency, one or more of the units being, as a rule, entirely stopped, depending on the amount of power required at a given time. Until some such experiments have been carried out, allowing for loss of efficiency in the transmission and giving credit for increased efficiency in propeller and motors, any argument must be purely hypothetical.

Deck Auxiliaries, Governing, etc.—The difficulty of driving the deck auxiliaries has not yet been satisfactorily solved, though experiments in the use of exhaust gases for producing steam in a donkey boiler are about to be made in more than one case, such as the boats under construction by the Nederlandsche Fabriek and the Hamburg-South American boats; the boiler is heated by an oil burner when in port, and this may prove to be the solution. Certainly, if for nothing else, it looks as if the heating of the ships would force steam to the front for the winches and whistle. With regard to the steering gear, we have already mentioned the possibilities of the Hele-Shaw hydraulic electric arrangement, described in a paper before the Naval Architects; further experience which is now being gained with this gear on the S. S. *Arama* should give more definite indication as to its value. Electric lighting would, of course, be obtained by a small internal combustion engine. Whatever the ultimate solution of the whole question of driving the auxiliaries, a solution is of great and growing importance in view of the increase in the sizes of ships to which internal combustion engines are being fitted. With regard to governing, we see no reason to depart from the opinions expressed in our leader of February 24 last year, though the matter must to a large extent remain one of opinion till such time as actual ocean tests have been made with internal combustion engines of sufficiently large size to enable a definite conclusion to be reached. The double-acting engine has not yet received a great deal of attention; indeed, it may be said that, with the exception of one firm on the Continent, the difficulties involved are being simply "funked," and yet it is perfectly obvious that it must come. Will the superintending engineer, for instance, be content to stand idly by while there exists a chance of nearly halving the cost, weight and space per horse-power, of his motive power, even at the risk of some initial mechanical difficulties.

Finally, as to the possible maximum horse-power which can be obtained on a single shaft with present-day knowledge; though a single engine of 1250 horse-power has actually run and given its power, while one of 2000 horse-power is under construction, and though rumor says that a three-cylinder engine of 6000 horse-power has run and run well, it is, in our opinion, hardly probable that an order for a reversible marine engine of more than 500 horse-power per cylinder could be placed today as a commercial proposition, and under any sort of guarantee that the superintending engineer might reasonably ask for.—*The Engineer.*

DEVELOPMENTS IN MARINE PROPULSION.—In reviewing the progress of marine engineering in the course of his presidential address at the Cleveland Institute of Engineers, Mr. H. Stonewall Jackson had naturally something to say regarding the internal combustion engine, particularly as his firm, Messrs. Richardsons, Westgarth & Co., Limited, are manufacturing engines of the Diesel type of 1000 horse-power for a 3200-ton vessel. He stated that although the weight of fuel used will be 60 per cent less, the cost will be about the same; but the saving in weight of fuel carried on a 30-day voyage will be about 270 tons, and to this extent the vessel, on the same draft and displacement, will have increased cargo capacity. In addition, there will be the saving in weight of the machinery, bunkers, etc., equal to about 70 tons, and a reduction in the engine-room staff equivalent to about £150 per annum. These estimates naturally justify a wider consideration, if not a more liberal attitude, on the part of builders and owners as to the potentialities of the system. At the present time there are two sea-going vessels in service with crude-oil engines. One is the *Vulcanus*, with a cargo capacity of 1000 tons on a 10-foot 2-inch draft, built at Amsterdam, and fitted with a six-cylinder, four-cycle, single-acting engine of 500 brake horse-power when running at 180 revolutions per minute. On a voyage from Rotterdam to Stockholm, a distance of 735 nautical miles, the time occupied, when fully laden with 1000 tons of cargo, was 100 hours, the

maximum speed being 8½ knots, and the consumption 1 ton of crude oil per 100 miles. The estimated saving over coal and steam engines is given as 50 per cent, without taking into consideration the reduction in *personnel* charges and the increase in cargo capacity. The other vessel is the *Toiler*, but by Messrs. Swan, Hunter and Wigham Richardson, Limited, of 2650 tons cargo capacity on a 14-foot draft. She has two Diesel engines, each of 180 brake horse-power, built by a Swedish firm. The results given by Mr. Jackson in this case apply to the first voyage from the Tyne to Calais, when the speed was 6¾ knots, and the consumption 1¾ tons of Texas oil per 24 hours, equal to a consumption of about 6d. per mile run with a full cargo of 2700 tons. There are also a large number of small vessels in use, all establishing the practicability of the system, while twelve sea-going vessels are now being built to be propelled with oil engines. Some data were also given relating to the application of coal-gas engines—notably in the *Holzapfel I*, a vessel 120 feet long, carrying 300 tons on a draft of 10 feet. This vessel, which has two producers, each of 100 horse-power capacity, and an engine with Föttinger reversing gear, attained a speed of 7½ knots. The actual consumption of fuel in the first seven voyages varied from 25 cwt. to 33 cwt. of coal per twenty-four hours when the vessel was carrying cargo varying from 242 to 340 tons. The initial cost of the engines and plant is slightly in excess of that for steam engines and boilers, but the saving in fuel—given as from 40 per cent to 60 per cent—compensates for the additional prime cost. The vessel uses anthracite coal in her producer, but many engineers are working at the problem of designing a producer which will use ordinary bituminous coal without the necessity of a gas-scrubbing plant. It is understood that Mr. Holzapfel proposes to construct a new vessel of large size utilizing the experience already gained in practice. Mr. Jackson had much to say also in favor of the use of liquid fuel in marine boilers, and gave the increase in calorific value as 75 per cent in weight over coal. Generally, the address contained much information regarding recent developments, notably in connection with the condenser problem.—*The Engineer.*

MARINE OIL ENGINES OR TURBINES: A COMPARISON.—A recent announcement in the various papers, to the effect that a torpedo-boat destroyer, presumably of some 20,000 shaft horse-power, is now building, and is to be fitted with a combination of steam turbines and reciprocating oil engines of the Diesel type, marks what is decidedly a new stage in the development of the marine engine for high-speed work.

The steam turbine and the heavy oil engine are progressing together, and each has been developing on its own lines for a not very different length of time. Undoubtedly the turbine has supplanted the reciprocating steam engine for high-speed work, and it is quite possible that in the near future its sphere of utility will be extended to even the slow-going tramp steamers.

The two predominant questions which are now arising are:

(1) Can the development of the Diesel marine engine proceed to such an extent as to supplant the turbine in its present premier position for large and high-powered installations—*e. g.*, liners and warships?

(2) Can it (starting, as it does, on practically equal terms) outstrip the turbine in the race for popularity in the future problem of the propulsion of merchant vessels?

Ten years ago the marine reciprocating steam engine had passed through such stages of evolution as to be regarded, to all appearances, as nearly as perfect a piece of mechanism as was possible to produce. With the exception of details, the chief strides seem to have been made in its infancy. The rise of pressure from slightly above the atmosphere to 200 pounds per square inch, and sometimes even higher, and consequent on this the recognition of the higher efficiency to be gained by utilizing to a higher degree the expansive property of the steam in the compound and triple-expansion engines, all took place within a comparatively short space of

time. Concurrently with this development was the natural and necessary evolution of the boiler, from the old, flat-sided iron boxes of the "atmospheric" period to the modern cylindrical boiler, and, last of all, to that marvel of lightness and strength, the water-tube boiler.

During the last ten or fifteen years the development of the water-tube boiler has been accompanied by the surprising and extraordinary evolution of the turbine, and as far back as 1904 it was easily seen that, as far as high speeds were concerned, the reciprocating engine was doomed.

A few of the reasons of the success of the turbine may be noted for purposes of comparison: (I) Its extreme simplicity and the absence of working parts. (II) It deals with steam at a far lower pressure than is possible in a "steam engine." (III) There is a considerable economy at high speeds. (IV) Its lightness and the comparatively small space occupied. (V) The initial pressure is comparatively low (170 pounds per square inch). (VI) Smaller staff required than for an equally powerful set of reciprocating engines. (VII) Absence of vibration, and the presence of water is not likely to have such an injurious effect as is the case in an ordinary steam cylinder.

There are, of course, against this, certain disadvantages, the chief of which are: (a) Loss of economy at low powers and the consequent introduction of cruising turbines. (b) Inability to go "astern" and the consequent introduction of separate astern turbines. (c) The necessity for a considerable increase in the capacities of various auxiliary engines to obtain the necessary high vacua. (d) With direct-coupled turbines and propellers the propeller speed is too high, and the turbine speed too low, for each to be working in the most efficient way.

An observation of an Entropy diagram of a set of reciprocating engines reveals the fact that the high-pressure cylinder is very efficient, whilst, owing to the limited expansion, the efficiency of the low-pressure cylinder shows a lamentable falling off.

On the other hand, owing to short blade heights and comparatively large leakage past the blade tips, a turbine somewhat lacks in efficiency at the high-pressure end, but on account of the very complete expansion of the steam, the low-pressure turbine is extremely economical.

Some distinct advantage may therefore be obtained in the matter of economy by using a high-pressure reciprocating engine in conjunction with a low-pressure turbine. This method has been employed with success in several cases.

Realizing the importance of improving the performance of the horse-power end of the reaction turbine, Parsons has now introduced an impulse stage, instead of the first reaction stage, with the advantage that a considerable drop of pressure takes place in the nozzles, followed by constant pressure through the stage of impulse blading, with little, or no tip leakage. This also enables the Parsons' turbine to cope with the coming demand for a moderate superheat.

In addition to this, an inspection of patent specifications will show that the "impulse" turbine, of which the "Curtis" is perhaps the best example, is undergoing considerable modification. In this turbine the last, or low-pressure nozzle stages have been done away with and a "drum" stage substituted. It is claimed that this "drum" stage is still a series of impulse stages, the fixed blades acting as nozzles. This is, however, doubtful, and it is quite possible that under the somewhat problematical condition of the low-pressure steam, the action is similar to that in a reaction turbine.

Thus with the Parsons' turbine modifying its horse-power end of the "Curtis" form, and the Curtis turbine modifying its low-pressure end to the "Parsons" form, it seems to point that in the near future the two types will merge and produce a "standard" marine turbine, the horse-power being of the "impulse" and the low pressure being of the reaction type.

Looking ahead, we will assume such a "standard" turbine fitted in a large ship such as a liner or battleship. Can such an installation be beaten by an "oil engine?" As regards economy "Yes," but as a practical fitting "No," and for the same reason that such vessels still burn coal. There is not enough oil fuel available.

Now turn to small, fast-running craft, which can burn oil fuel alone. It is more difficult to give a direct answer, owing to the greater thermal efficiency of the Diesel engine. Still, no *simpler* or more easily managed installment can at present be imagined than one consisting of a set of "standard" turbines supplied with steam from oil-fired boilers. The question of auxiliaries is also of paramount importance.

However, in both the above cases—*i. e.*, the large ship burning coal and oil, and the small ship burning oil alone—the introduction of an oil engine to the propelling machinery appears to have considerable advantages, especially in the matter of "astern" working, and the development of steam generation for low-pressure turbines, by means of the exhaust gases, would be watched with interest.

Coming now to the merchant class of steamer, having few auxiliaries, here the oil engine should have an exceptionally profitable field to work, as all the elements for success are present with the exception of cost of fuel. These elements are:

(1) High thermal efficiency.
(2) The question of weight is not of great importance.
(3) Greater radius of action or increased cargo capacity.
(4) We have an engine running at a low speed of revolution, thus securing both an engine and a propeller, each running at a speed conducive to high efficiency, without the obvious disadvantages of intermediate gearing, whether spur gearing, hydraulic or electrical. In such a ship the steam necessary for the production of fresh water, etc., could quite easily be generated by the waste heat in the exhaust.

In conclusion, it is perhaps unnecessary to add that *the* mechanism to which all engineers are looking forward, but which seems still in the far distance, is the gas or oil turbine.—*Marine Engineering and Naval Architect.*

GROWTH IN SIZE OF THE TURBINE.—The application of the turbine to marine propellers commenced in 1897, at a period when the efficiency of the new prime mover had been well established. The famous little *Turbinia* of 1897, 100 feet in length, which was driven at 32.75 knots by turbines of 2300 horse-power, showed a steam consumption per shaft horse-power per hour, for all purposes, of 15 pounds. In 1905 the cruiser *Amethyst* was driven by turbines of 14,000 horse-power at a speed of 23.63 knots, with a steam consumption of 16.6 pounds per shaft horse-power per hour for all purposes, and in 1907 the *Mauretania* and *Lusitania*, with turbines of 74,000 horse-power, made 26 knots, with a steam consumption, for all purposes, of 14.4 pounds per shaft horse-power.—*Scientific American.*

THE CARELS DIESEL MARINE ENGINE.—This oil engine has been brought to its present sound and reliable design by Messrs. Carels Frères, of Ghent, after several years of scientific investigation and practical experiment. It is of the two-stroke single-acting type, and is capable of burning the heaviest oils on an economical consumption.

The engine resembles closely in general appearance the standard form of mercantile marine steam engine; indeed, the lower parts may be said to be identical with the same, and therefore need no description. The cylinders also resemble those of a steam engine in the manner in which they are carried on the columns, and in having the inner barrel or liner a separate casting inserted into the outer barrel or jacket. Near the bottom of the liner there is a series of circumferential ports, matching corresponding ports of the jacket casting, which open into a belt sur-

rounding the cylinder. On this belt a branch or facing is formed, to which is bolted the exhaust main, the whole being designed to provide the freest possible exit for the products of combustion. As a precaution against any possible leakage of exhaust gas past the piston into the engine-room, a stuffing-box, packed with metallic rings, is fitted at the bottom end of the liner. A lantern-ring in the middle of this stuffing-box communicates with a circular chamber connected to the suction of the scavenging pump, by which means any escape of exhaust gas into the engine-room is rendered practically impossible.

The piston itself is packed with spring rings of the Ramsbottom type, and is water cooled, the water being circulated through the hollow piston rod by means of walking pipes, or by a pump worked from the crosshead. Ample water-cooling spaces are provided between the liner and jacket of the cylinder, the water being introduced at the bottom and discharged at the top into the cylinder cover. This cover is a strong jacketed casting, jointed and bolted to the cylinder in the usual manner, and carrying all the valves necessary for the operation of the cycle. In each cover there are four scavenging valves, which open simultaneously and admit a column of air, which effectually clears out the residue products of combustion. The fuel-oil injection valve is placed in the center of the cover, and in front of this is the air starting valve, while at the back there is a spring-loaded relief valve. The various valves are operated through levers actuated by cams carried on a shaft, which is supported by bearings bracketed to the cylinder jacket. The drive to this cam shaft is transmitted from the crank shaft by means of a vertical shaft and spiral gear wheels at the center of the engine.

The high-pressure air for injection of the fuel oil is obtained from a multiple-stage air-compressor coupled to the forward end of the main crank shaft. The scavenging and injection air discharges are distributed to the cylinders by suitable mains. The fuel-oil measuring pumps are driven by the cam shaft, and one pump is provided for each cylinder. The quantity of oil discharged can be regulated by hand from the starting platform, while an independent governor control is also provided. The circulating water pump is conveniently driven by the levers operating the scavenging pumps, which in addition, are utilized for working the bilge and sanitary pumps, as in accepted steam practice. Lubrication is by gravity or ring, except to the pistons, for which a forced system is provided, the pressure being maintained by a pump.

Coming now to the method of operating and controlling the engine, the following description will enable this to be understood: The cams for operating the scavenging valves are of symmetrical form, and can be set to the correct position for ahead or astern running by altering the angular relationship of the cam and crank shafts. The partial rotation of the cam shaft required to bring this about is effected by raising or lowering the vertical driving shaft, which, by engagement of the spiral gear wheels, causes the cam shaft to revolve through the desired angle, the crank shaft, of course, remaining stationary. The movement of the vertical shaft is produced by a servo-motor operating through a rack and pinion and connecting rod coupled to a lever embracing a sleeve on the vertical shaft, the whole arrangement being such that in either extreme position the gear is practically self locking. The piston of the servo-motor is operated by compressed air, and smoothness of action is ensured by the addition of an oil-brake cylinder.

The cams for the fuel injection and air starting valves of each cylinder are in duplicate, there being one set for ahead and one set for astern running. By means of a special auxiliary or maneuvering shaft, parallel with and adjacent to the cam shaft, the rollers of the valve levers are brought into contact with the appropriate cams in the following manner (assuming the engine is about to be started in the astern direction after having been running ahead). In the "stop" position of the maneuvering gear the rollers are all clear of the cams. Thus the maneuvering shaft is

free to slide axially in order to bring the rollers opposite the astern cams. This longitudinal movement is effected by the servo-motor at the same time as the cam shaft is rotated. The maneuvering shaft is then rotated by means of a geared hand wheel, thereby causing the rollers to be brought into contact with the cams.

The details of the mechanism cannot conveniently be described without fuller drawings, but it may be said that by the interposition of specially shaped auxiliary cams on the maneuvering shaft the air starting valves on all cylinders are first brought into action and then gradually cut out and the fuel-injection valves switched in, all this being effected by turning a hand wheel at the starting platform. This same maneuvering shaft brings the measuring pumps into action at the appropriate times, and, finally, when the engine is set to "full speed" position, cuts off the air supply to the starting valves through a regulating valve on the main, thus preventing any possible leakage.

The control mechanism on the starting platform is arranged as follows: The larger and lower of the two vertical hand wheels is the hand reversing gear, which takes the place of the servo-motor should this be out of action. Below this wheel the air cylinder of the servo-motor can be distinguished, while above it is the maneuvering hand wheel. The vertical hand lever carried on the maneuvering wheel bracket operates a cock admitting air to the servo-motor. By the manipulation of this lever and hand wheel the engine can be started, stopped, and reversed at pleasure. The small hand wheel, in an inclined position above the maneuvering wheel, sets the governor for the desired speed of engine, while the quadrant and lever immediately underneath provide an independent hand adjustment of the measuring pumps. All the essential controls are interlocked, so that it is impossible to operate them in any but the correct sequence when stopping and reversing.—*Engineering.*

ELECTRIC PROPULSION OF SHIPS.—At a joint meeting of the Boston Society of Civil Engineers and the Boston sections of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers held on December 20, Mr. W. L. R. Emmet, of the General Electric Company, Schenectady, N. Y., delivered an illustrated lecture upon the electric propulsion of ships. The speaker reiterated his well-known views upon the subject and emphasized the importance of securing trial installations in large ships, which offer the most attractive savings under operation by electric motors. The general advantages of the motor drive for high-powered propellers were reviewed, including a substantial reduction in the strains upon shafts, certainty of decreased fuel consumption through increase in prime-mover efficiency, extension of cruising radius and diminution in the weight of boilers, machinery and fuel to be carried.

Mr. Emmet contended that the engineering problem of ship propulsion by electric motors supplied with energy from turbo-generators is beset by no serious difficulties. The conservatism of large ship builders and governmental officers appears to be the chief obstacle to the early application of a representative electrical installation on the large scale necessary for a striking demonstration of economy. It appears certain that when such an installation is made it will be done at a great decrease in initial cost as well as accompanied by radical reductions in operating expense. After several years of sustained effort permission has been secured from the United States Government to equip the 20,000-ton collier *Jupiter* with electrical propulsion machinery, and, although delays are being experienced on account of the scarcity of suitable labor, the construction of the ship is now under way at the Mare Island Navy Yard. The *Jupiter* will be equipped with 7000 horse-power in induction-motor propeller drives, the speed of the vessel being 14 knots. The equipment will weigh only 145 tons and will be located practically on the ship's bottom. It is expected that power will be delivered at the shaft with a steam consumption

of 12 pounds per horse-power hour. It will be impossible for the turbo-generator to deliver much more current upon short-circuit than the full-load current of the propeller motors. The apparatus is simple in the extreme. The turbine speed will be about 2000 revolutions per minute, which is high enough to enable the full economy of the turbine to be realized.

Taking up the problem of direct propeller driving of turbines, Mr. Emmet said that this involves speeds below the most efficient range of the prime movers, resulting in a great increase in size and cost, as well as a larger fuel consumption. The mechanical difficulties of driving propellers of large ships through gearing are very serious. In very small vessels gear drives may be reasonably successful, but in meeting the power demands of battleships and trans-Atlantic liners the gearing problem is one of almost insuperable difficulty. High turbine speed is the secret of economical operation, and this can only be positively secured under present conditions by the electric motor drive. The weight of the 6800 horse-power triple-expansion engines of the similar collier *Cyclops* is 335 tons, or more than twice the weight of the propulsive equipment of the *Jupiter*, and the steam consumption of the former is probably about 14½ pounds per shaft horse-power hour, or nearly 21 per cent more than is expected in the case of the electrically driven ship. For the same power the *Jupiter* turbine will weigh but one-tenth that of the direct-connected propeller turbines used on the *Lusitania*. The latter deliver 30,000 horse-power and are obliged to run at the low speed of 180 revolutions per minute, which prohibits securing the legitimate economy of this type of prime mover.

The speaker showed that the electrical equipment of a 17,000 horse-power liner built to run at 17.5 knots would save the owner $20,000 a year in fuel alone, without allowing for any reduction in boiler weight. In the trans-Atlantic service this would enable the vessel to carry 900 tons additional cargo. The estimated steam consumptions were 14½ pounds with quadruple-expansion engines and 11 pounds with the turbo-electric drive. The cost of installing the latter would be at least $50,000 less than the bare expense of the engines. The labor cost of operating large marine engines is also far greater than the expense of handling the turbo-electric equipment. So great is the fuel saving possible with the electric drive that it is estimated that the battleship *Wyoming*, if electrically propelled could travel at cruising speed two-thirds of the distance around the world with a single coaling. The details of auxiliary apparatus in connection with electric propulsion are being carefully developed, special attention having been given to the successful production of a form of salt-water-cooled resistance capable of absorbing large amounts of energy in connection with the reversal of the driving machinery. Over 350 kilowatts have been absorbed by such an apparatus incased in a cylinder about 12 inches high and 6 inches in diameter. The speaker stated that as soon as the electrical equipment is completed at the factory it will be subjected to economy tests in which the conditions of propeller service will be to a large extent duplicated. Preliminary engineering analyses and many former turbine tests indicate that a great field for electrical service is close at hand.—*Electrical World.*

CRUDE-OIL FUEL IN THE FRENCH NAVY.—The French Navy Department is taking measures towards using petroleum residues more extensively in the future for heating marine boilers, owing to the advantages which are now so well recognized as coming from the oil fuel. This is one of the indications which show that the question of substituting oil for coal is occupying the attention of different countries. Oil is likely to be largely used in the future either for burning under boilers, or for operating the new Diesel and other crude-oil engines which are now being made in units of increasing size. As regards the use of oil residues in the French Navy, the late Minister of the Marine, Admiral Boué de Lapeyrère, is quite in favor of it, and a number of plans are now being promoted which will lead to a more extensive use of this fuel. It is now recognized that it

will be of great use in the navy owing to the greater speed and ease in taking fuel on board the vessels, and the greater radius of action which a boat will have owing to the greater amount of fuel represented as heat-giving power, which can be taken in the available given space.

All the new torpedo destroyers of the navy are installed for firing the boilers with "mazout" or petroleum residues of European origin. Up to the present the French seaports were not well equipped for handling and storing the oil, so that the cost per ton was very high and much more than in other leading countries. Measures are now being taken to organize more modern methods for handling the oil in the leading French ports, so that this country will be one of the foremost in this field. At the military ports such as Toulon, Brest and Cherbourg are now being installed great oil reservoirs in which the petroleum residue will henceforth be stored up, and besides this a very complete system is being organized, as the navy has purchased a steamer to be used specially for oil transport. It will ship the oil at the Roumanian port of Constanza in the Mediterranean region, which is one of the leading shipping centers for this product, and will then bring the mazout to the French ports and fill up the reservoirs directly, without the extra handling which heretofore brought up the cost to £6 9s. per (long) ton, while it will be now reduced to £2 14s. per ton. The new steamer has been named the *Rhone*, and it gauges 7000 tons. It is also of interest to note that the 26,000-ton battleships *Courbet* and *Jean Bart* of the French fleet, as well as the new units which are to be constructed, will be fitted with the necessary appliances so that they can burn crude oil or residues at the same time as coal, making thus a combination system.—*Scientific American.*

MISCELLANEOUS.

CHANGES IN ADMIRALTY CHARTS.—Notice is given that on and after January 1, 1912, true bearings will be introduced as soon as practicable in all British Admiralty publications. Details of the new system are as follows:

(a) *On Charts.*—A new pattern compass is already being gradually introduced which enables true bearings to be laid off on the chart, in addition to magnetic bearings as at present. The compass consists of two graduated circles, clearly separated from each other. The outer circle is a true compass, graduated from 0 degree (true north) to 360 degrees, measured clockwise. The inner circle is a magnetic compass, graduated in points and degrees from 0 degree to 90 degrees as heretofore. The bearings of leading and clearing marks, etc., will be given both true and magnetic, and a note to this effect will be placed on the title of the charts. As examples the following are interesting. The bearing S. 40 degrees W. true, with a variation of 12 degrees E. will be shown thus: 220 degrees (S. 28 degrees W. mag.).

(b) *In Sailing Directions.*—Bearings will be given as true only, in degrees from 0 degree (N.) to 360 degrees, measured clockwise; and a note to this effect will be given in the title page, in the advertisement, and in the page immediately preceding page 1 of all volumes of sailing directions. The variations will continue to be given on each map as at present, so the magnetic bearings may be obtained when required. This alteration will be introduced gradually.

(c) *In Notices to Mariners.*—All bearings will be given both true and magnetic in a similar manner to that adopted on charts, the necessary alteration being made in the heading of the notices.

(d) *Lists of Lights.*—Bearings will be given as true only, in degrees from 0 degree (N.) to 360 degrees, measured clockwise. On each page of the Lists of Lights in which this alteration has been carried out a footnote will be placed stating that all bearings are true from seaward.—*The Marine Engineer and Naval Architect.*

DETERMINATION OF POSITION IN FOG.—The U. S. N. Hydrographic Office has just made known the results of important experiments from the cruiser *Washington*, off Nantucket lightship, last September, made for the purpose of determining in a fog the distance between a ship and a lightship or shore station. Knowing that wireless telegraph waves travel almost instantaneously within short distances, while the sound from a submerged bell or an aerial whistle takes an appreciable and definite time to travel a certain distance, the experimenters were able by the aid of chronometers to fairly approximate the actual distance of the cruiser from Nantucket lightship, when the wireless signal, the whistle and the submerged bell all signalled at precisely the same moment. Thus, if the bell signal reached the cruiser nine seconds later than the wire signal, given at the same time, it was easy to calculate the distance from the lightship, allowing 4794 feet per second as the velocity of sound in water.—*The Marine Engineer and Naval Architect.*

SHIPS' BOATS DURING ACTION.—Discussion in respect to the disposal of the boats of a fleet before going into action, has been exercising the minds of certain writers in the press, and divers means have been suggested as to the best time and the best methods for ships out to meet the enemy, to divest themselves of these inconvenient appendages while engaging the enemy. So far as we can see, there is only one practical method of ensuring that boats are not in the way, or are not a standing danger to the crew of a warship as firewood or material to shower splinters around, when search is being made for the enemy. This method is to leave all but one or two on board each fighting ship, at the base from which the ships start, and set those one or two adrift the moment an enemy is sighted; as to do this with a couple of light boats would take but little time. If the weather was smooth enough the auxiliaries, repair and mother ships accompanying a battle fleet might take the boats in tow during an action, and restore them to their respective vessels when the large ships again met their auxiliaries, or came back from the fighting line for boats to carry out humane duties among the beaten ships of their cruisers. If the weather was too rough for this, then the only boats for use of the fleet would be those carried by the auxiliaries, which had not been in the fighting line to get their boats injured, and for this purpose as many boats as convenient should be carried by fleet auxiliaries during a naval campaign. That at least is a practical plan.—*United Service Gazette.*

EVOLUTION OF NAVAL VICTUALLING.—The navy appears to be gradually approaching the period when, as fore-shadowed in the report of the Login Committee, there will be general messes in all ships and establishments, and such canteens as are required will be run by the Admiralty. This is known as the "all navy" system, and is asked for by the men in their annual "Magna Charta," the profits from the canteen to be used as a naval benevolent fund, administered by Admiralty representatives, and representatives chosen from the lower deck by the men themselves. Naturally there has been a good deal of opposition to, and criticism of, such a scheme; since there are vested interests, to which we have more than once hinted, which would be seriously upset. Meantime the Admiralty have had reason to draw the attention of the commanding officers of the navy to the fact that canteen contractors introduce and sell inferior brands of articles at standard prices, fixed for the best class of goods; and to instruct those responsible to see that such cases are reported to the Admiralty, so that the contractors concerned may be dealt with from Whitehall if necessary. The system set up by the Login Committee provides a Scrutiny Committee in each ship, composed of officers and men whose duty it is to see that no fraud of this sort is perpetrated; but like the old Canteen Committees, which they replaced, these committees are

evidently not doing their work as they ought to do, and the men are consequently exposed to unfair tricks by the contractors.—*United Service Gazette.*

TO MAKE SHIPS UNSINKABLE.—Some far-reaching results are looked forward to by the inventors of the new compressed air device for keeping ships afloat after damage by grounding or collision which is being tried in certain battleships of the American Navy. The invention is based on the same principle that has enabled the Arbuckle Wrecking Co. to keep many damaged ships afloat, and in brief it provides that when a vessel has been holed, the water can be driven out by compressed air, "thus permitting the holes to be repaired from within." But it is not stated in the reports at present to hand how this is done; presumably the men sent to do the repairs would be provided with suitable helmets to enable them to work satisfactorily at the greater air pressure, which must, of course, be maintained until the breach in the ship's hull has been closed. A test of the system was made recently in the *North Carolina* by permission of the Navy Department. The seacocks were opened and one of the watertight compartments flooded, and then compressed air at a pressure of 12 pounds to the square inch was forced into the compartment through a small opening. In ten minutes all the water had been forced back into the river. It was necessary, during the time the pressure was being applied to the flooded compartment, to force compressed air at a pressure of 7 pounds to the square inch into all the adjoining compartments, and at a pressure of 3 pounds into those next to the latter, in order to prevent buckling. The captain of the *North Carolina* is reported to have declared that a method had now been found for the first time of making ships practically unsinkable, and for affixing repairs to the hull below the waterline from the inside, either after collision or during a naval battle. To equip a vessel with the system the necessary pipes and gauges have only to be attached to the compressed air plant which every ship at present carries for blowing off poisonous gases and the like. Further experiments are being made in the new battleship *Utah*, the outcome of which will be awaited with interest.—*Army and Navy Gazette.*

THE HYPOSCOPE.—A general on the field of battle wants to see without getting shot. So also does an artillery commander. The enemy naturally take the opposite view, and in these days of long-range weapons and telescopes any staff which shows on a hilltop at once finds itself a target for infantry, artillery, and machine guns. Foreign armies are therefore beginning to issue portable observing ladders to artillery and to general officers. However, even the observing ladder is not altogether satisfactory; the general cannot be expected to go up it himself, and if set up so as to give a wide field of vision it is difficult to conceal from all points of view. It is now suggested, in some quarters, that the hyposcope is better than the ladder. This instrument is a long telescope with a binocular eyepiece in the center and an object glass at each end. It can be used straight, when it gives great stereoscopic effect, or can be doubled up so that the two arms project upwards. These arms can be drawn out to a length of 6 feet, or in large instruments to 12 feet, so as to give a view over the top of a hill, while the tripod mounting supports the eyepiece at the height of the eye. A large instrument has to be heavy in order to prevent vibration in the wind, but it is pointed out that the observing ladder requires a cart, or, at least, a pack aminal to transport it, whereas the hyposcope is lighter than the ladder. At any rate, it will be easier for an elderly general to look through the hyposcope than to climb a ladder or to go up in a balloon.—*Army and Navy Gazette.*

WRECK OF THE "MAINE."—The President sent to Congress on December 14 the report of the Vreeland board on the wreck of the *Maine*. The President's message was as follows:

To the Senate and House of Representatives:

A board of naval officers, of which Admiral Vreeland was the senior member and of which Colonel William M. Black, of the corps of engineers of the army, was also a member, by order of the Secretary of the Navy, was convened at Habana on November 20, 1911, to inspect the wreck of the *Maine* and make a report thereon.

The board finds that the injuries to the bottom of the *Maine*, as described in the report, were caused by the explosion of a charge of a low form of explosion exterior to the ship between frames 28 and 31, strake B, port side. This resulted in igniting and exploding the contents of the 6-inch reserve magazine, A-14-M, said contents including a large quantity of black powder. The more or less complete explosion of the contents of the remaining forward magazines followed. The magazine explosions resulted in the destruction of the vessel.

I have the honor to transmit herewith the full text of the report.

The White House, Dec. 14, 1911. WM. H. TAFT.

The findings of this board were as follows:

38. The port garboard strake between 27½ and 31 was dished upward along its outboard edge as much as 24 inches from a straight line between 27½ and 31, the dish disappearing about 31. At a buttstrap in this garboard strake midway between frames 30 and 31 the after plate and strap were found pulled away from the forward plate and upward fully 6 inches farther than the after end of the forward plate, having been torn loose from the flat keel plate by parting the rivets on the seam between 30½ and 31.

39. B strake was reinforced for its entire length by a continuous longitudinal. This B plate parted the rivets along its inboard seam from 30½ forward to 27½, across the buttstrap at 27½ and aft along its outboard seam to 28.

40. The next plate outboard, C strake, was torn irregularly from 28 inboard to 29 outboard and parted the rivets along the outboard seam as far aft as frame 33, remaining attached to B strake along its inboard seam from frame 28 aft. This plating, formed of B and C plates, as just described, an area of approximately 100 squart feet, wos displaced upward, inward, and to starboard through approximately 180 degrees, having swung about an axis from about 30½ inboard and forward to about 31½ outboard and aft.

41. The transverse floor plates between the outer skin plating, above described, and the inner bottom plating were crumpled. The part of the inner bottom plating directly over this section of outside plating was displaced inward and aft and crumbled in numerous folds.

42. The longitudinal directly over the center of B plate parted its fastenings, broke about frame 28, was twisted, the forward end was displaced upward, and left approximately 6 feet above its original position.

43. The board finds that the injuries to the bottom of the *Maine*, above described, were caused by the explosion of a charge of a low form of explosive exterior to the ship between frames 28 and 31, strake B, port side. This resulted in igniting and exploding the contents of the 6-inch reserve magazine, A-14-M, said contents including a large quantity of black powder. The more or less complete explosion of the contents of the remaining forward magazines followed. The magazine explosions resulted in the destruction of the vessel.

C. E. VREELAND,
Rear-Admiral, U. S. N., Senior Member.
R. M. WATT,
Chief Constructor, U. S. N., Member.
W. M. BLACK,
Colonel, Corps Engrs., U. S. A., Member.
JOSEPH STRAUSS,
Commander, U. S. N., Member.
C. F. HUGHES,
Commander, U. S. N., Member and Recorder.

—*Army and Navy Register.*

THE "MAINE" ONCE MORE AFLOAT.—The second week in February the wooden bulkhead which has been built across the forward end of the unwrecked portion of the *Maine* being completed, sufficient water was admitted within the coffer-dam to free the hull from the mud into which it had deeply settled. The *Maine* rode on a fairly even keel, but on account of the removal of heavy weights and particularly of the after-turret with its two 10-inch guns, the hull floated considerably above its normal water-line. —*Scientific American.*

THE PRESENT STATUS OF WIRELESS TELEGRAPHY.—In a lecture recently delivered at Berlin, Count G. von Arco, after outlining the general working of the main parts of radio-telegraphic installation, began their detailed discussion with the consideration of the antenna problem. Vertical antennas which until quite recently were those most generally in use, are carried by huge masts which must assume enormous dimensions whenever long distances are to be spanned. In fact, the problem of long-range radio-telegraphy has long been dependent almost exclusively on the design of antennas. Whether electric waves are transmitted through the air, the earth or both media simultaneously was until recently an open question, though there was strong evidence in favor of the earth transmission theory. However, the systematic work done by Dr. Kiebitz at the instigation of the German Postal Department has now shown the earth as such to be capable of transmitting electric energy to considerable distances, while sufficient receiving energy, even at the greatest distances, may be derived from the earth alone. The Telefunken Company, on the strength of these experiments, has designed many types of earth antennas exerting well-directed effects and apparently preferable in other respects to aerial antennas. The system becomes much more independent of disturbance due to atmospheric discharges and to the interference of other stations. For the rest the electrical behavior of earth antennas is very similar to that of aerial antennas. As regards, next, the modern system of musical "damped" sparks, this has been further improved upon, and the new apparatus, though of simple design, allows the pitch of the sound to be readily altered. The Nauen Experimental Station (near Berlin), which equalled in power and range the two largest Marconi stations (viz., those connecting England with Canada) has recently been raised to an output four times the initial figure. The height of the tower (originally 330 feet) has been doubled, and two new engines and apparatus halls have been fitted up.—*Scientific American.*

WIRELESS WAVES.—In recent tests carried out in Washington, D. C., for the purpose of determining the law of the variation of strength of signal with distance, it was found that over salt water the electrical waves decrease in intensity in proportion to the distance as found by Duddell and Taylor. In addition they are subject to an absorption which varies with the wave length. This is true in general for day transmission. The absorption at night is entirely irregular, varying from zero to the day value, but is on an average much less during winter than in summer. The received antenna currents between two stations with salt water between are proportional to the product of the heights of the sending and receiving antennas and inversely proportional to the wave length, provided the antenna resistances remain constant. These experiments were made with flat-top antenna heights of from thirty to eighty feet and wave lengths of from approximately 1500 to 4000 meters.—*The Navy.*

TRAINING OF MIDSHIPMEN.—*Fewer Ship Changes.*—The Admiralty have had under review the system of the appointment of midshipmen laid down in Admiralty letter issued May, 1910. Experience has shown that the transfer of midshipmen from one ship to another at the end of their first and second years' training, together with the normal changes of ship due to recommissioning, refit, etc., have resulted in the young officers

serving for so short a period in any one ship that their value as an integral part of the ship's complement and their training afloat are apt to be seriously prejudiced. Accordingly, the Admiralty will endeavor to arrange for midshipmen to remain in the ships to which they are appointed until the end of the commission or until they are due for examination for the rank of lieutenant. Midshipmen will be appointed to such ships as are allowed midshipmen by complement so far as the numbers permit, and all appointments will be made by the Admiralty. The procedure whereby appointments to "B" ships are made by commanders-in-chief will be discontinued.

The Admiralty consider it desirable that midshipmen should continue to be lent to the smaller cruisers or destroyers in small numbers and for short periods, and commanders-in-chief are authorized to make arrangements for this whenever a suitable opportunity arises. The midshipmen should be lent only, and should return to their parent ships, and the total period in their three years' service during which they are so lent should not exceed three to four months.—*Army and Navy Gazette.*

THE EDUCATION OF NAVAL OFFICERS.—Mr. Sanders, on behalf of Lord C. Beresford, asked the First Lord of the Admiralty on the 16th inst., whether the system of education for officers inaugurated in 1902 was satisfactory in every particular; whether he was aware that the Admiralty memorandum of 1902 stated that officers having attained the rank of sub-lieutenant, specialization should begin and should be definite and final, that the committee appointed to consider the subject under Admiral Sir Archibald Douglas in 1905 stated that there would be no need for a final division into three branches, that specialization for a period only was necessary; whether the entry of marine officers from outside on the same principle as before the Admiralty memorandum of 1902 had now been determined upon, and, if so, whether he would state how many marine officers had joined under the old system and how many under the new; whether upwards of 1500 cadets and midshipmen had already entered under the new system, of whom each, according to his merits, would have an opportunity of becoming an Admiral of the Fleet or filling the office of First Sea Lord of the Admiralty; and if he would state to the House whether the Admiralty had abolished specialization or whether they had not abolished it, and so make the question clear to those hundreds of families who gave their sons to the service of the country.

Mr. Churchill: The answer to the first part of the question is in the affirmative so far as the main lines of the scheme are concerned, but experience has shown that some modification in details is required. The answer to the second part of the question is in the affirmative. As regards the third part, the direct entry of marine officers has been determined upon as supplementary to the system of common entry, but the scheme of training after entry will be more comprehensive than formerly and will include instruction in naval as well as in military subjects. No marine officers have at present joined under either the old or the new scheme. The answer to the fourth part of the question is in the affirmative. As regards the last part, the policy of the Admiralty has been fully explained in circular letter No. 25 of August 14 last, which states precisely the conditions under which officers will be allowed to specialize. Engineer officers in future will belong to the military branch, and officers who specialize in engineering may or may not remain specialists within that branch throughout their career. As a general rule, officers who join the Royal Marines will remain attached to the corps throughout their whole career.—*United Service Gazette.*

EXHIBITION OF THE AMERICAN RED CROSS SOCIETY.—The American Red Cross desires again to invite attention to the exhibition in connection with the Ninth International Red Cross Conference, which will be held in Washington, D. C., from May 7 to 17, 1912.

The exhibition will be divided into two sections, which will be styled Marie Feodorovna and General. The former is a prize competition, with prizes aggregating 18,000 rubles, or approximately $9000, divided into nine prizes, one of 6000 rubles, approximately $3000; two of 3000 rubles each, and six of 1000 rubles each.

The subjects of this competition are as follows:

(1) A scheme for the removal of wounded from the battlefield with the minimum number of stretcher bearers.

(2) Portable (surgeons') washstands, for use in the field.

(3) The best method of packing dressings for use at first aid and dressing stations.

(4) Wheeled stretchers.

(5) Transport of stretchers on mule back.

(6) Easily folding portable stretchers.

(7) Transport of the wounded between warships and hospital ships, and the coast.

(8) The best method of heating railway cars by a system independent of steam from the locomotive.

(9) The best model of portable Roentgen apparatus, permitting utilization of X-rays on the battlefield and at first aid stations.

The maximum prize will be awarded to the best exhibit, irrespective of the subject, and so on.

The General Exhibit is again divided into two parts; the first will be an exhibition by the various Red Cross Associations of the world. The second will be devoted to exhibits by individuals or business houses of any articles having to do with the amelioration of the sufferings of sick and wounded in war, which are not covered by the Marie Feodorovna Prize Competition for the year. While the American Red Cross will be glad to have any articles pertaining to medical and surgical practice in the field, it is especially anxious to secure a full exhibit relating to preventive measures in campaign. Such articles will be classified as follows:

(1) Apparatus for furnishing good water in the field.

(2) Field apparatus for the disposal of wastes.

(3) Shelter such as portable huts, tents and the like, for hospital purposes.

(4) Transport apparatus (to prevent the suffering of sick and wounded) exclusive of such apparatus as specified for the Marie Feodorovna Prize Competition.

As with the Marie Feodorovna Prize Competition, for this country only articles having the approval of the Central Committee of the American Red Cross will be accepted.

Diplomas will be awarded for exhibits in this section of the exhibition as approved and recommended by the jury.

Further information may be obtained from the Chairman, Exhibition Committee, American Red Cross, Washington, D. C.

It is perhaps to apparatus having to do with prevention of disease in armies that the energies of Americans have been specially directed since the Spanish-American War. Therefore, the last-mentioned section of the exhibition should make an appeal to them.

AVIATION NIGHT SIGNAL.—A night signal of the kind that aviators will need in the future is now being used at the Treptow Observatory, near Berlin, in connection with atmospheric experiments. It consists of a crimson balloon, a little more than three yards in diameter, carrying an electric light in its center and a hygrometer, or instrument for measuring atmospheric changes, attached to a bell. The wires of the electric light are used as the guide rope of the balloon. When the balloon is sent up to a level free of fog, the registering instrument communicates with the bell, and thus the balloon's arrival in clear air is announced to those who are working it from the ground. These balloons are easily visible at night, and can be readily distinguished from other sources of illumination.—*United Service Gazette.*

WAR OFFICE COMPETITION.—A tremendous impetus should be given to aeroplane construction by the War Office competition. The conditions appear to have been drawn up with exceptional skill and taken together they form an exacting proposition which, if the prize money is to be worthily won will call for a considerable improvement upon anything which has been hitherto attained. An important condition is that the machine must carry a live load of 350 pounds in addition to its equipment of instruments, etc., with fuel and oil for 4½ hours. Under these conditions it must fly for 3 hours and maintain an altitude of 4500 feet for 1 hour, the first 1000 feet being attained at the rate of 200 feet a minute, although a rate of rise of 300 feet per minute is specified as desirable. Loaded as described, it must attain a speed of not less than 55 miles per hour in a calm. Among other attributes of great importance from a military point of view is the fitting of an effective silencer and the manipulation of the engine by the pilot alone. Flexibility of speed is very properly to receive attention, and among other conditions of great importance one notes stability and suitability for use in bad weather.—*Page's Weekly.*

SPECIFICATION FOR A MILITARY AEROPLANE.—The following conditions are those required to be fulfilled by a military aeroplane:

(1) Be delivered in a packing case suitable for transport by rail, and not exceeding 32 feet by 9 feet by 9 feet. The case must be fitted with eyebolts to facilitate handling.

(2) Carry a live load of 350 pounds in addition to its equipment of instruments, etc., with fuel and oil for 4½ hours.

(3) Fly for 3 hours loaded as in Clause 2, and maintain an altitude of 4500 feet for 1 hour, the first 1000 feet being attained at the rate of 200 feet a minute, although a rate of rise of 300 feet per minute is desirable.

(4) Attain a speed of not less than 55 miles per hour in a calm (loaded as in Clause 2).

(5) Plane down to the ground in a calm from not more than 1000 feet with engine stopped, during which time a horizontal distance of not less than 6000 feet must be traversed before touching.

(6) Rise without damage from long grass, clover, or harrowed land in 100 yards in a calm, loaded as in Clause 2.

(7) Land without damage on any cultivated ground, including rough plough, in a calm, loaded as in Clause 2, and pull up within 75 yards of the point at which it first touches the ground when landing on smooth turf in a calm. It must be capable of being steered when running slowly on the ground.

(8) Be capable of change from flying trim to road transport trim, and travel either on its own wheels or on a trolley on the road; width not to exceed 10 feet.

(9) Provide accommodation for a pilot and observer, and the controls must be capable of use either by pilot or observer.

(10) The pilot and observer's view of the country below them to front and flanks must be as open as possible, and they should be shielded from the wind, and able to communicate with one another.

(11) All parts of aeroplane must be strictly interchangeable, like parts with one another and with spares from stock.

(12) The maker shall accurately supply the following particulars, which will be verified by official test:

(a) The horse-power and the speed given on the bench by the engine in a six hours' run.

(b) The engine weight, complete (general arrangement drawing), and whether air or water-cooled.

(c) The intended flying speed.

(d) The gliding angle.

(e) Weight of entire machine.

(f) Fuel consumption per hour at declared horse-power.

(g) Oil consumption per hour at declared horse-power.

(h) Capacity of tanks.
(13) The engine must be capable of being started up by the pilot alone.
(14) Other desirable attributes are:
(a) Stand still with engine running without being held. Engine preferably capable of being started from on board.
(b) Effective silencer fitted to engine.
(c) Strain on pilot as small as possible.
(d) Flexibility of speed; to allow of landings and observations being made at slow speeds if required, while reserving a high acceleration for work in strong winds.
(e) Good glider, with a wide range of safe angles of descent, to allow of choice of landing places in case of engine failure.
(f) It is desirable that the time and number of men required for the change from flying trim to road trim, or packed for transport by rail, and *vice versa*, should be small, and these will be considered in judging the machine. The time for changing from road trim and packed condition to flying trim to include up to the moment of leaving the ground in flight, allowance being made for difficulty in starting engine.
(g) Stability and suitability for use in bad weather and in a wind averaging 25 miles per hour 30 feet from the ground without undue risk to the pilot. Stability in flight is of great importance.
(h) The packing case for rail transport to be easily dismantled and assembled for use, and when dismantled should occupy a small space for storage.—*Engineering*.

THE AEROPLANE IN WAR.—One of the most interesting features of last summer's military maneuvers in France, and also of the conflict in Tripoli, is the lesson they have given of the influence of the aeroplane in war. Briefly, it has been found that it is impossible to conceal any movements from an enemy possessing a force of aeroplanes. The effect of this will be most far reaching, and it is interesting to speculate on the results.

If we assume that two armies are of fairly equal numbers and equally well supplied with information by their aeroplanes, it seems that it is possible for a sort of stalemate to ensue. Normally, one army would attack the other, massing a sufficient number of troops at the decisive point to give it a large numerical superiority there. It is now generally admitted that it is useless to attack, at a given point, an army supplied with modern long-range weapons unless there is a very great numerical superiority at that point. Such massing of troops, however, absolutely depends on keeping the enemy in ignorance of the intended movements, for if they are aware of the number and position of the troops moved, they can equally well mass troops for the defence. It seems quite possible, therefore, that neither side could dare to take decisive action. It is, however, not the least likely that any two armies would be equally well supplied with information by their aeroplane corps. Just as one army is usually able to penetrate or force back the cavalry screen of the other, and to obtain valuable information, so one army, by dint of superior forces of airmen, or by greater daring, will generally be better supplied with information than the other, and will have a proportionate advantage.

It is, however, quite possible, in fact probable, that the matter may go much further than this. It appears to be assumed by many writers that each side will allow the other to use aeroplanes for reconnoitring purposes without any opposition, save that which can be offered by shooting at them from the earth. This, however, is to ignore all the teaching of history. The art of war lies greatly in anticipating the enemy's movements, either by intuition or by obtaining information, and also in leading him to form incorrect opinions as to the *locus* of the attack to be made on him. Wellington said that he had spent his military life in guessing what was happening on the other side of the hill. The principles of strategy are constant, and it is certain that no commander can ever hope for success who tamely views his opponent inspecting his lines and makes no

effort to frustrate him. Just as every battle has hitherto been preceded with skirmishes of outposts, followed by an artillery duel, so in the future there will be fights in the air before the men on the ground come into contact. The side with the greatest force of aeroplanes will never let an enemy's machine fly over their own position without sending a superior force of aeroplanes to capture or destroy it. As defeat in the air means certain death, it may be presumed that in many cases surrender would be preferred, and in this case a very short time would see one side in possession of complete command of the air, and therefore able to get all the information it required without allowing the enemy to get any.

This might in itself render even a very large army perfectly helpless, as every endeavor to advance would only lead it into carefully prepared positions. On the other hand, the smaller army could always find out the weak points to attack. If the numerical superiority of the enemy were too great for attack to be made at all, stalemate might result; but it must be remembered that huge armies cannot be kept in the field indefinitely, owing to the enormous expense, and to the fact that calling out all the reserves means the withdrawal of the workmen from the various productive industries of the country. Unless such an army can attack, it must be eventually disbanded, and peace made on the best terms obtainable.

While this is all we may, perhaps, expect at the present time, the rapid progress of the aeroplane makes it interesting to speculate on the results of an equally rapid increase in its efficiency in the future. The money hitherto expended in constructing aeroplanes has been measured in thousands, but if this were increased to a very few millions, it is quite possible that in the near future aerial fleets capable of carrying several thousand men with light guns and a supply of explosives could be produced. In the face of such a force any army without aeroplanes would be useless, for it would be unable to keep up its communications. In fact, it would be unable even to protect its base. The aerial fleet could roam about the country at will destroying the railways, telegraphs, and other means of communication. The recent railway strike has shown us what the interruption of railway communication means even for a few days, and it is quite certain that a very short spell of it would reduce any country to making peace.

It is of the utmost importance that we should thoroughly appreciate the importance of these points. Owing to the smallness of our population, and the fact that we do not have conscription, it is quite impossible for us to keep up a huge army as do the Continental powers. We have hitherto kept command of the sea, and it is now becoming equally important to have complete command of the air. It is therefore high time that we determined that we will do so, and that, however many aeroplanes any other power builds, we will build more, just as we do with the ships. Further, that however many men any other power trains to flying; we will train more. We have plenty of men who would make as good, or better, flying men than any if it were made worth their while; but we must have a really good government school and flying ground, and reasonably good pay must be given. It is also necessary that constructors should be encouraged to put up factories in England at which aeroplanes can be turned out in numbers, to provide for the wastage of war.

We therefore welcome, as a preliminary to more important developments, the fact that the War Office have published the conditions of a competition for aeroplanes, to be held about the middle of next year. As we have already said, it is undoubtedly high time that something was done to encourage military aviation in this country, and we are therefore very glad that this competition has been decided upon.

A list of the prizes offered, and a statement of the conditions of the competition, are printed on page 840 of the present issue, and it is unnecessary, therefore, to repeat them here. Taking them all round, these conditions appear very fair. It is, however, to be regretted that more money is not being spent on prizes for British-made machines, and that

there appears to be no encouragement to the use of British engines. It is just as important that we should build our military aeroplanes in this country as our fighting ships, and therefore the sooner a substantial amount of money is spent on fostering the industry the better.

With regard to the technical conditions there appears to be little fault to find. There are, however, several points which may entail a good deal of modification in existing machines. Thus it is not at all certain that the landing chassis of the ordinary aeroplane will comply with the conditions laid down as to alighting and starting on rough ground. There is no doubt that in this matter many machines are capable of a great deal of improvement. We have before commented on this and on the very small wheels generally fitted. If the standard wheels will not comply with the conditions, however, it seems likely that the principal alteration required will be an increase in the size of the wheels, or some modification of the skids.

The requirement that the aeroplane shall carry two persons, and that it shall be capable of being controlled by either, may necessitate some modification of existing machines, but this will not be great. The condition that the view of the country should be as open as possible both to the pilot and to the observer may not be easy to fulfil in some types, especially when taken in conjunction with the stipulation that the men are to be shielded from the wind. The usual position occupied by the pilot in a monoplane complies with the latter condition very well, but not altogether with the former. On the other hand, the position of the pilot at the front edge of the front plane in a biplane affords an excellent view, but exposes him to the wind. It appears possible that the best view of any would be obtained from a monoplane with the wings set out about a foot from the body. The increased stress due to this would be very small, and the view in every direction very good. There may, of course, be some practical objection to this plan, but it seems worth a trial.

If the condition that the engine must be capable of being started by the pilot alone means that he must be able to set it in rotation without assistance in holding the aeroplane, it implies either some form of anchorage or else brakes sufficient to prevent the machine from moving. Possibly the latter will be necessary to ensure stopping in the space specified. There does not seem to be any theoretical difficulty in fitting brakes to hold the machine with the engine running. If it be preferred not to have these, it would be quite easy to arrange for an anchorage with a trip-gear to release the aeroplane when required.

While there appears to be little to criticize in the conditions, it is perhaps a pity that a definite date for the competition was not announced, so that competitors should know exactly when their machines are to be ready. There is also no indication of what relative importance will be attached to the various points. Probably this is wise, as it leaves the committee a freer hand in their awards, and it is only by experience that the relative importance of different features can be ascertained.—*Engineering.*

ANNUAL REPORT OF THE SECRETARY AND TREASURER OF THE U. S. NAVAL INSTITUTE.

ANNAPOLIS, MD., March 16, 1912.

TO THE OFFICERS AND MEMBERS OF THE INSTITUTE:

Gentlemen:—I have the honor to submit the following report for the year ending December 31, 1911.

On Feb. 23, 1912, the Board of Control decided that the accounts of the Institute should be audited at the earliest convenient date by a firm of public accountants.

Black & Company, of Baltimore, were awarded this contract, and completed their work on March 15, 1912. In place of the report being submitted in the usual form, their report in full is published:

BALTIMORE, MARYLAND, March 12, 1912.

TO THE OFFICERS AND MEMBERS OF THE UNITED STATES NAVAL INSTITUTE, ANNAPOLIS, MARYLAND:

Gentlemen.—In accordance with instructions from your Secretary and Treasurer, Lieut.-Commander Ralph Earle, U. S. N., under date of March 6, 1912, we have made an exhaustive examination of the records, books of account, etc., of the

UNITED STATES NAVAL INSTITUTE, ANNAPOLIS, MARYLAND,

for the year ended December 30, 1911, and herewith submit *certified balance sheet* as of December 30, 1911, together with the following exhibits:

Exhibit A.—Cash account.
Exhibit B.—Investments (bonds).
Exhibit C.—Statement of cash receipts and disbursements.
Exhibit D.—Operations for the year ended December 30, 1911.
Exhibit E.—Trial balance, December 30, 1911.

Our investigation has been very thorough and complete, including an examination for the entire year of all checks and vouchers covering the cash disbursements; proving all additions in cash book and ledgers; checking all postings into ledgers, and verification of cash, securities and surplus accounts. We were unable to verify the $164.25, consisting of checks, money orders and cash in safe in office, as of December 30, 1911, as our examination did not begin until March 8; but we did count the actual cash, etc., as of February 9, 1912, and found it to agree with cash-book balance.

As a result of our examination we have made some verbal recommendations which will, we think, greatly facilitate the work of your office and

enable statements to be set up showing the actual condition of your Institute. We would also make the following suggestions:

First.—That *all* cash receipts be deposited in bank, and *all* cash disbursements be made by check; and, if it is found necessary to make any payments in cash, to provide your cashier with a petty cash fund out of which payments can be made, receipts taken and periodical reimbursement made to him.

Second.—That the outstanding check #634 of $2.00 which we are advised has been lost, be taken up as a cash receipt, and that the error of $.01 be treated in a like manner.

Third.—That the difference, between the estimated marked value of the bonds owned by your Institute and the valuation as per the books, be charged off.

The general condition of the books of account, records, etc., of your Institute, is such, as to merit commendation; and we acknowledge, with thanks, the uniform courtesy shown us and the cheerful assistance rendered us by your office force while we have been engaged in making this examination.

Respectfully submitted,
BLACK & COMPANY,
By Wilmer Black, C. P. A.
Certified Public Accountants.

UNITED STATES NAVAL INSTITUTE, ANNAPOLIS, MD.

BALANCE SHEET, DECEMBER 30, 1911.

ASSETS.

Cash (Exhibit A)		$12,601.66
Investments (Exhibit B)		46,097.67
Accounts receivable		2,809.36
Accrued interest		112.50
Inventory		2,700.00
Furniture and fixtures		300.00

LIABILITIES.

Accounts payable		$ 1,255.09
Reserve fund		6,753.14
Balance January 1, 1911	$ 6,663.14	
Transferred from General Fund	90.00	
Surplus		56,612.96
Balance January 1, 1911	$56,432.57	
Net Profit for year ended December 30, 1911. (See Exhibit D)	180.39	
		$64,621.19 $64,621.19

We hereby certify that the above *balance sheet* is a true and correct exhibit of the condition of the *United States Naval Institute, Annapolis, Maryland,* as of *December 30, 1911,* as disclosed by the books of account.

BLACK & COMPANY,
By Wilmer Black, C. P. A.
Certified Public Accountants.

Dated at Baltimore, Maryland, March 12, 1912.

EXHIBIT A.

CASH ACCOUNT, DECEMBER 30, 1911.

Seaman's Bank for Savings, New York City...			$ 3,000.00
Balance, as per letter dated March 2, 1912...		$3,000.00	
Rhode Island Hospital Trust Co., Providence, R. I.			2,929.40
Balance, as per letter dated March 12, 1912...		2,929.40	
Society for Savings, Hartford, Conn.			2,913.94
Balance, as per letter dated March 12, 1912...		2,972.20	
Interest not taken up until after Jan. 1, 1912..		58.26	
		$2,913.94	
Farmers' National Bank, Annapolis, Md.			3,594.07
Balance, as per balanced bank pass book, balanced February 6, 1912		$4,840.99	
Less Deposits.			
January 12, 1912	$ 830.13		
Draft	67.67		
January 11, 1912	132.95		
January 25, 1912	328.22		
February 6, 1912	1,445.99		
		2,804.96	
		$2,036.03	
Add Checks drawn in 1912.			
#897	$ 9.21		
898	87.50		
899	70.20		
900	49.00		
902	40.00		
903	160.00		
904	1,248.14		
905	.95		
906	6.00		
907	75.00		
908	50.00		
909	87.50		
		1,883.50	
		$3,919.53	
(Checks #901, 910 and 911 still out.)			
Less Outstanding Checks.			
#634	$ 2.00		
810	12.00		
815	5.00		
868	170.40		
873	136.00		
		325.40	
		$3,594.13	
Less.			
Error of Bank (over)	$ .01		
Error Jones check #736	.05		
		.06	
		$3,594.07	
In Safe in Office.			
Checks		$ 67.71	
Money Orders		9.19	
Cash		87.35	
			164.25
			$12,601.66

EXHIBIT B.

SECURITIES (BONDS) DECEMBER 30, 1911.

Face value of bonds.	Name of company.	Amount as per books.	Estimated market value.
$ 6,000.00	Southern Railway 6-$1000 5% Registered Gold Bonds.	$ 6,745.14	$ 6,432.00
2,000.00	Washington Railway & Electric Co. 2-$1000 4% 50 yr. Gold Bonds Consolidated Mortgage.	1,715.00	1,720.00
18,000.00	Northern Pacific & Great Northern R. R. 8-$1000 Joint Bonds Registered. 2-$5000 C. B. & O. Collateral Registered.	17,718.83	17,460.00
2,000.00	Potomac Electric Power Co. 2-$1000 1st Mortgage 5%.	2,115.00	2,030.00
9,000.00	Northern Pacific Railway 4-$1000 3% Registered Gold Bonds. 1-$5000 3% Registered Gold Bond. General Lien due January, 2047.	8,902.45	6,120.00
9,000.00	B. & O. R. R. Co. 1-$5000 1st Mortgage 4% 50 year Gold Registered. 1-$1000 1st Mortgage 4% 50 year Gold Registered. 3-$1000 Prior Lien 3½% due 1925.	8,901.25	8,842.50
$46,000.00		$46,097.67	$42,604.50

EXHIBIT C.

STATEMENT OF CASH RECEIPTS AND DISBURSEMENTS FOR THE YEAR ENDED DECEMBER 30, 1911.

Balance, January 1, 1911		$16,823.52
RECEIPTS.		
Dues	$ 1,934.63	
Subscriptions	1,251.53	
Sale of Books	24,280.62	
Sale of Proceedings	73.84	
Advertisements	849.27	
Interest on Investments	2,235.01	
Postage	16.37	
Binding	37.12	
Life Membership Fee	60.00	
Rebate on Insurance	71.50	
Sundries	43.03	
Total Receipts	$30,852.92	30,852.92
		$47,676.44
Balance, January 1, 1912		$12,601.66

DISBURSEMENTS.

Printing and Binding Proceedings	$ 4,196.11
Printing and Binding Extra Publications	13,392.51
Salaries	3,250.00
Contributors	2,533.05
Authors of Text-Books (Royalties)	4,483.20
Postage and Telegrams	583.51
Expressage, freight and hauling	85.53
Purchase of Books for Sale	835.67
Office Expenses—Stationery, supplies, etc.	220.92
Foreign Copyright and Royalties	117.41
"War on the Sea," "Genius of Naval Warfare." Prize Essay Award	213.95
Honorable Mention Award	180.00
Purchase Northern Pacific & Great Northern R. R. Bonds	4,815.69
Refunds	10.28
Rent of Safe Deposit Box	5.00
Engraving Prize Essay Medal and Case	10.75
Subscription to Magazines	8.32
Subscription to Naval Directory	1.10
Purchase of back numbers of Proceedings	11.00
Insurance on Institute Property	80.00
Attorney's Fee	40.00
Discount on drafts	.77
Total Disbursements	$35,074.78
Balance, December 30, 1911 (Exhibit A)	12,601.66
	$47,676.44

EXHIBIT D.

OPERATIONS FOR THE YEAR ENDED DECEMBER 30, 1911.

Inventory, January 1, 1911.			
Back numbers of Proceedings	$ 200.00		
Extra Publications	1,000.00		
		$ 1,200.00	
Purchases.			
Books for Sale	$ 835.67		
Back numbers of Proceedings	11.00		
		846.67	
Printing and Binding Proceedings	$ 4,500.28		
Printing Extra Publications	13,392.51		
		17,892.79	
		$19,939.46	
Inventory, December 30, 1911.			
Back numbers of Proceedings	$ 200.00		
Extra Publications	2,500.00		
		2,700.00	
Cost of *Publications* sold		$17,239.46	$17,239.46
Profit on *Sale* of *Publications*			6,016.14
			$23,255.60

EXPENSES.

Postage and Telegrams	$ 567.14	
Expressage, freight and hauling	84.03	
Exchange	.32	
Insurance	8.50	
Contributors	2,533.05	
Salaries	3,250.00	
Authors of books (Royalties)	4,483.20	
Office Expenses (stationery, supplies, etc.)	227.87	
Foreign Copyright and Royalties	117.42	
"War on the Sea," "Genius of Naval Warfare.		
Transferred to Reserve Fund	90.00	
Prize Essay Award	213.95	
Honorable Mention Award	180.00	
Refunds	10.28	
Attorney's Fee	40.00	
Rent of Safe Deposit Box	5.00	
Engraving Prize Essay Medal and Case	10.75	
Subscription to Magazines	8.32	
Subscription to Naval Directory	1.10	
Total Expenses	$11,830.93	$11,830.93
Net Profit		180.39
		$12,011.32
Sale of Books	$23,164.69	
Sale of Proceedings	90.91	
Total Sale of Publications	$23,255.60	$23,255.60
Profit on Sale of Publications		$ 6,016.14
Dues	$ 1,847.81	
Subscriptions	1,255.53	
Advertisements	525.50	
Interest on Investments	2,235.01	
Bindings	30.25	
Sundries	41.08	
Life Membership Fee	60.00	
	$ 5,995.18	5,995.18
		$12,011.32

EXHIBIT E.

TRIAL BALANCE, DECEMBER 30, 1911.

Cash	$12,601.66	
Investments	46,097.67	
Reserve Fund		$ 6,663.14
Surplus		56,432.57
Dues		1,841.81
Subscriptions		1,255.53
Sale of Books		23,164.69
Sale of Proceedings		90.91
Advertisements		525.50
Interest on Investments		2,235.01
Postage	556.14	
Binding		30.25
Expressage	82.68	
Sundries		41.08

EXHIBIT E.—Continued.

Exchange	$ .32	
Life Membership Fees		$ 60.00
Cash in exchange for checks		6.73
Insurance	8.50	
Printing and Binding Proceedings	4,500.28	
Printing Extra Publications	13,392.51	
Contributors	2,533.05	
Salaries	3,250.00	
Authors of Books	4,483.20	
Telegrams	11.00	
Purchase of Books for Sale	835.67	
Stationery	155.89	
Purchase of Drafts	124.15	
Freight and Hauling	1.35	
Prize Essay Award	213.95	
Honorable Mention Award	180.00	
Rapid Addressing Machine Co.	41.75	
Rebates	10.28	
Office Expense	15.03	
Stenographer and Typewriting	15.20	
Rent of Safe Deposit Box	5.00	
Engraving Prize Essay Medal and Case	10.75	
Subscription to Magazines	8.32	
Subscription to Naval Directory	1.10	
Purchase of Back Numbers of Proceedings	11.00	
Attorney's Fee	40.00	
Accounts Receivable	2,809.36	
Accrued Interest	112.50	
Inventory December 30, 1911	1,200.00	
Furniture and Fixtures	300.00	
Accounts Payable		1,255.09
	$93,608.31	$93,608.31

The second suggestion made by this firm has been carried out. The first and third suggestions are under consideration.

The investments, hitherto carried at price paid for them including brokerage, will, if carried at market value of December last, show an apparent decrease in the surplus of $3,493.13.

The actual net gain during the year has been therefore $180.39.

A change, suggested by the accountants, has been made in the method of bookkeeping which simplifies, in a measure, the work connected therewith, and enables quickly a balance to be struck and a full report to be rendered of operations at any time that it is desired.

Respectfully,

RALPH EARLE,
Lieut.-Commander, U. S. Navy,
Secretary and Treasurer.

BOOK NOTICES.

"The United States Navy." A hand book, by Henry Williams, Naval Constructor, U. S. Navy. New York: Henry Holt & Co., 1911, 228 pages. illustrated with numerous half-tone engravings and line cuts. Price, $1.50.

Naval Constructor Williams, U. S. Navy, from his experience at sea, as well as on shore, is well qualified to write on this subject.

Many of those questions that every person in the naval service has been asked hundreds of times are answered authoritatively and in a non-technical manner.

The book opens with a chapter on Naval History; then follow chapters on The Navy's Organization; Personnel; Man-of-War in Commission; Classes of Ships; High Explosives; Mines; Torpedoes and Aeroplanes; Designing and Building a Warship, Dry Docks, and closes with a chapter on the National Defense.

The information given is accurate and will prove interesting to those who have some interest in the navy.

There is an excellent index, which will undoubtedly increase its value as a reference book.

W. B. WELLS.

"A Manual of International Law"; for the use of naval officers, by Rear-Admiral C. H. Stockton, U. S. N. Annapolis: Naval Institute, 1911. 313 pp.

The manual before us represents the experience gained in the practice of international law by its author during a long and especially useful career as an officer of the United States Navy; a career which may be said to have culminated in his fortunate incumbency of the office of superintendent of the Naval War College at Newport, Rhode Island. There is no place, certainly in the United States, where instruction in international law is carried on with such systematic thoroughness, or where better or more practical results are obtained, and this is due, in great part, to the intelligent and well-directed endeavors to that end which were put forth by Admiral Stockton, and by Professors Snow and Wilson who cooperated with him in the establishment of the school upon its present basis. A notion of the extent and character of the work done at the War College may be obtained from the annual volumes of its Proceedings—a work of standard and permanent value.

The manual is primarily intended for the use of naval officers, as is indicated by its title. The book is not quite equally divided between peace and war; a comparatively full presentation of the former being necessary in the discussion of the subjects of territory, including boundaries, insurgency in its relation to belligerency, jurisdiction on the high seas and nationality, all of which are of the first importance to officers of the navy. In the portion devoted to war, belligerency, neutrality, maritime capture,

blockade, contraband, the right of search and unneutral service are all of them thoroughly and lucidly discussed in the light of the most recent authorities. The old rules of maritime capture, which have recently been made the subject of conventional amendment, are brought fully up to date; the most recent of these, the Convention of London of 1907, is treated in great detail and at sufficient length. This is as it should be, for that convention, if generally and fully adopted and followed, is calculated to bring about very material changes in the practice of maritime warfare.

It was an earlier American author, the late Major-General Halleck, whose work on international law was required to be carried on board every public armed vessel in the British Navy. It is fortunate, indeed, that Admiral Stockton's excellent work on the same subject is to occupy a similar place in the navy of the United States. For that purpose a better selection could not possibly have been made.

GEO. B. DAVIS.

(Reprinted from the American Journal of International Law, Washington, D. C., January, 1912.)

LIST OF PRIZE ESSAYS.

1879.

Naval Education. Prize Essay, 1879. By Lieut.-Com. A. D. Brown, U. S. N.

NAVAL EDUCATION. First Honorable Mention. By Lieut.-Com. C. F. Goodrich, U. S. N.

NAVAL EDUCATION. Second Honorable Mention. By Commander A. T. Mahan, U. S. N.

1880.

"The Naval Policy of the United States." Prize Essay, 1880. By Lieutenant Charles Belknap, U. S. N.

1881.

The Type of (I) Armored Vessel, (II) Cruiser best suited to the Present Needs of the United States. Prize Essay, 1881. By Lieutenant E. W. Very, U. S. N.

SECOND PRIZE ESSAY, 1881. By Lieutenant Seaton Schroeder, U. S. N.

1882.

Our Merchant Marine: The Causes of its Decline and the Means to be taken for its Revival. "Nil clarius aquis." Prize Essay, 1882. By Lieutenant J. D. J. Kelley, U. S. N.

"MAIS IL FAUT CULTIVER NOTRE JARDIN." Honorable Mention. By Master C. G. Calkins, U. S. N.

"SPERO MELIORA." Honorable Mention. By Lieut.-Com. F. E. Chadwick, U. S. N.

"CAUSA LATET: VIS EST NOTISSIMA." Honorable Mention. By Lieutenant R. Wainwright, U. S. N.

1883.

How may the Sphere of Usefulness of Naval Officers be extended in Time of Peace with Advantage to the Country and the Naval Service? "Pour encourager les Autres." Prize Essay, 1883. By Lieutenant Carlos G. Calkins, U. S. N.

"SEMPER PARATUS." First Honorable Mention. By Commander N. H. Farquhar, U. S. N.

"CULIBET IN ARTE SUA CREDENDUM EST." Second Honorable Mention. By Captain A. P. Cooke, U. S. N.

1884.

The Reconstruction and Increase of the Navy. Prize Essay, 1884. By Ensign W. I. Chambers, U. S. N.

1885.

Inducements for Retaining Trained Seamen in the Navy, and Best System of Rewards for Long and Faithful Service. Prize Essay, 1885. By Commander N. H. Farquhar, U. S. N.

1886.

What Changes in Organization and Drill are Necessary to Sail and Fight Effectively Our Warships of Latest Type? "Scire quod nescias." Prize Essay, 1886. By Lieutenant Carlos G. Calkins, U. S. N.

THE RESULT OF ALL NAVAL ADMINISTRATION AND EFFORTS FINDS ITS EXPRESSION IN GOOD ORGANIZATION AND THOROUGH DRILL ON BOARD OF SUITABLE SHIPS. Honorable Mention. By Ensign W. L. Rodgers, U. S. N.

1887.

The Naval Brigade: its Organization, Equipment and Tactics. "In hoc signo vinces." Prize Essay, 1887. By Lieutenant C. T. Hutchins.

1888.

Torpedoes. Prize Essay, 1888. By Lieut.-Com. W. W. Reisinger, U. S. N.

1891.

The Enlistment, Training and Organization of Crews for our Ships of War. Prize Essay, 1891. By Ensign A. P. Niblack, U. S. N.

DISPOSITION AND EMPLOYMENT OF THE FLEET: SHIP AND SQUADRON DRILL. Honorable Mention, 1891. By Lieutenant R. C. Smith, U. S. N.

1892.

Torpedo-boats: their Organization and Conduct. Prize Essay, 1892. By Wm. Laird Clowes.

1894.

The U.S.S. Vesuvius, with Special Reference to her Pneumatic Battery. Prize Essay, 1894. By Lieut.-Com. Seaton Schroeder, U. S. N.

NAVAL REFORM. Honorable Mention, 1894. By Passed Assistant Engineer F. M. Bennett, U. S. N.

1895.

Tactical Problems in Naval Warfare. Prize Essay, 1895. By Lieut.-Com. Richard Wainwright, U. S. N.

A SUMMARY OF THE SITUATION AND OUTLOOK IN EUROPE. An Introduction to the Study of Coming War. Honorable Mention, 1895. By Richmond Pearson Hobson, Assistant Naval Constructor, U. S. N.

SUGGESTIONS FOR INCREASING THE EFFICIENCY OF OUR NEW SHIPS. Honorable Mention, 1895. By Naval Constructor Wm. J. Baxter, U. S. N.

THE BATTLE OF THE YALU. Honorable Mention, 1895. By Ensign Frank Marble, U. S. N.

1896.

The Tactics of Ships in the Line of Battle. Prize Essay, 1896. By Lieutenant A. P. Niblack, U. S. N.

THE ORGANIZATION, TRAINING AND DISCIPLINE OF THE NAVY PERSONNEL AS VIEWED FROM THE SHIP. Honorable Mention, 1896. By Lieutenant Wm. F. Fullam, U. S. N.

NAVAL APPRENTICES, INDUCEMENTS, ENLISTING AND TRAINING. The Seaman Branch of the Navy. Honorable Mention, 1896. By Ensign Ryland D. Tisdale, U. S. N.

THE COMPOSITION OF THE FLEET. Honorable Mention, 1896. By Lieutenant John M. Ellicott, U. S. N.

1897.

Torpedo-boat Policy. Prize Essay, 1897. By Lieutenant R. C. Smith, U. S. N.

A PROPOSED UNIFORM COURSE OF INSTRUCTION FOR THE NAVAL MILITIA. Honorable Mention, 1897. By H. G. Dohrman, Associate Member, U. S. N. I.

TORPEDOES IN EXERCISE AND BATTLE. Honorable Mention, 1897. By Lieutenant J. M. Ellicott, U. S. N.

1898.

Esprit de Corps: A Tract for the Times. Prize Essay, 1898. By Captain Caspar Frederick Goodrich, U. S. N.

OUR NAVAL POWER. Honorable Mention, 1898. By Lieut.-Com. Richard Wainwright, U. S. N.

TARGET PRACTICE AND THE TRAINING OF GUN CAPTAINS. Honorable Mention, 1898. By Ensign R. H. Jackson, U. S. N.

1900.

Torpedo Craft: Types and Employment. Prize Essay, 1900. By Lieutenant R. H. Jackson, U. S. N.

THE AUTOMOBILE TORPEDO AND ITS USES. Honorable Mention, 1900. By Lieutenant L. H. Chandler, U. S. N.

1901.

Naval Administration and Organization. Prize Essay, 1901. By Lieutenant John Hood, U. S. N.

1903.

Gunnery in Our Navy. The Causes of its Inferiority and Their Remedies. Prize Essay, 1903. By Professor Philip R. Alger, U. S. N.

A NAVAL TRAINING POLICY AND SYSTEM. Honorable Mention, 1903. By Lieutenant James H. Reid, U. S. N.

SYSTEMATIC TRAINING OF THE ENLISTED PERSONNEL OF THE NAVY. Honorable Mention, 1903. By Lieutenant C. L. Hussey, U. S. N.

OUR TORPEDO-BOAT FLOTILLA. The Training Needed to Insure its Efficiency. Honorable Mention, 1903. By Lieutenant E. L. Beach, U. S. N.

1904.

The Fleet and Its Personnel. Prize Essay, 1904. By Lieutenant S. P. Fullinwider, U. S. N.

A PLEA FOR A HIGHER PHYSICAL, MORAL AND INTELLECTUAL STANDARD OF THE PERSONNEL FOR THE NAVY. Honorable Mention, 1904. By Medical Inspector Howard E. Ames, U. S. N.

1905.

American Naval Policy. Prize Essay, 1905. By Commander Bradley A. Fiske, U. S. N.

THE DEPARTMENT OF THE NAVY. Honorable Mention, 1905. By Rear-Admiral Stephen B. Luce, U. S. N.

1906.

Promotion by Selection. Prize Essay, 1906. By Commander Hawley O. Rittenhouse, U. S. N.

THE ELEMENTS OF FLEET TACTICS. First Honorable Mention, 1906. By Lieut.-Com. A. P. Niblack, U. S. N.

GLEANINGS FROM THE SEA OF JAPAN. Second Honorable Mention, 1906. By Captain Seaton Schroeder, U. S. N.

THE PURCHASE SYSTEM OF THE NAVY. Third Honorable Mention, 1906. By Pay Inspector J. A. Mudd, U. S. N.

1907.

Storekeeping at the Navy Yards. Prize Essay, 1907. By Pay Inspector John A. Mudd, U. S. N.

BATTLE REHEARSALS. A few thoughts on our next step in Fleet-Gunnery. First Honorable Mention, 1907. By Lieut.-Comdr. Yates Stirling, U. S. N.

THE NAVAL PROFESSION. Second Honorable Mention, 1907. By Commander Bradley A. Fiske, U. S. N.

1908.

A Few Hints to the Study of Naval Tactics. Prize Essay, 1908. By Lieutenant W. S. Pye, U. S. N.

THE MONEY FOR THE NAVY. First Honorable Mention, 1908. By Pay Inspector John A. Mudd, U. S. N.

THE NATION'S DEFENSE—THE OFFENSIVE FLEET. How Shall We Prepare It for Battle? Second Honorable Mention, 1908. By Lieut.-Commander Yates Stirling, U. S. N.

1909.

Some Ideas about Organization on Board Ship. Prize Essay, 1909. By Lieutenant Ernest J. King, U. S. N.

THE NAVY AND COAST DEFENCE. Honorable Mention, 1909. By Commodore W. H. Beehler, U. S. N.

THE REORGANIZATION OF THE NAVAL ESTABLISHMENT. Honorable Mention, 1909. By Pay Inspector J. A. Mudd, U. S. N.

A PLEA FOR PHYSICAL TRAINING IN THE NAVY. Honorable Mention, 1909. By Commander A. P. Niblack, U. S. N.

1910.

The Merchant Marine and the Navy. Prize Essay, 1910. By Naval Constructor T. G. Roberts, U. S. N.

THE NAVAL STRATEGY OF THE RUSSO-JAPANESE WAR. Honorable Mention, 1910. By Lieutenant Lyman A. Cotten, U. S. N.

1911.

Navy Yard Economy. Prize Essay, 1911. By Paymaster Charles Conard, U. S. N.

NAVAL POWER. Honorable Mention, 1911. By Captain Bradley A. Fiske, U. S. N.

WANTED—FIRST AID. Honorable Mention, 1911. By Commander C. C. Marsh, U. S. N.

1912.

Naval Might. Prize Essay, 1912. By Lieutenant Ridgely Hunt, U. S. N. (retired).

INSPECTION DUTY AT THE NAVY YARDS. Honorable Mention, 1912. By Lieut.-Commander T. D. Parker, U. S. N.

NOTICE.

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It now enters upon its thirty-eighth year of existence, trusting as heretofore for its support to the officers and friends of the Navy. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers and communications upon subjects of interest to the naval profession, as well as by personal support and influence.

On the subject of membership the Constitution reads as follows:

ARTICLE VII.

Sec. 1. The Institute shall consist of regular, life, honorary, and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fees to the Secretary and Treasurer. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

Sec. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control, and a vote equal to one-half the number of regular and life members, given by proxy or presence, shall be cast, a majority electing.

Sec. 5. Associate members shall be elected from Officers of the Army, Revenue Cutter Service, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: "Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control, and, if their report be favorable, the Secretary and Treasurer shall make known the result at the next meeting of the Institute, and a vote shall then be taken, a majority of votes cast by members present electing."

The Proceedings are published quarterly and anyone may subscribe for them. The annual subscription is $3.00; single copies, 75 cents. Annual dues for members and associate members, $2.00. Fee for life membership, $30.00.

All letters should be addressed U. S. Naval Institute, Annapolis, Md., and all checks, drafts, and money orders should be made payable to the same.

SPECIAL NOTICE.

NAVAL INSTITUTE PRIZE ESSAY, 1913.

A prize of two hundred dollars, with a gold medal, and a life-membership in the Institute, is offered by the Naval Institute for the best essay presented on any subject pertaining to the naval profession, subject to the following rules:

1. The award for the prize shall be made by the Board of Control, voting by ballot and without knowledge of the names of the competitors.

2. Each competitor to send his essay in a sealed envelope to the Secretary and Treasurer on or before January 1, 1913. The name of the writer shall not be given in this envelope, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary and Treasurer, with the motto on the outside and writer's name and motto inside. This envelope is not to be opened until after the decision of the Board.

3. The successful essay to be published in the Proceedings of the Institute; and the essays of other competitors, receiving honorable mention, to be published also, at the discretion of the Board of Control; and no change shall be made in the text of any competitive essay, published in the Proceedings of the Institute, after it leaves the hands of the Board.

4. If, in the opinion of the Board of Control, the best essay presented is not of sufficient merit to be awarded the prize, it may receive "Honorable Mention" or such other distinction as the Board may decide.

5. In case one or more essays receive "Honorable Mention," the writer of the first of them in order of merit will receive seventy-five dollars and a life-membership in the Institute.

6. Any essay not having received honorable mention may be published also, at the discretion of the Board of Control, but only with the consent of the author.

7. The essay is limited to fifty (50) printed pages of the Proceedings of the Institute.

8. All essays submitted must be either typewritten or copied in a clear and legible hand.

9. In the event of the prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of the gold medal.

By direction of the Board of Control.

RALPH EARLE,
Lieut.-Commander, U. S. N., Secretary and Treasurer.